

## DESCRIPTION

Data Processing Apparatus, Data Processing Method,  
Terminal Unit, and Transmission Method of Data

## 5 Processing Apparatus

## Technical Field

10 The present invention relates to a data  
process for moving and copying contents data between a  
server having a large storage memory and a memory card,  
in particular, to a data processing apparatus, a data  
processing method, a terminal unit, and a transmission  
method of a data processing apparatus for storing data  
move/copy history information to a non-volatile memory  
15 and for prohibiting and permitting contents data from  
being (to be) moved and copied from the server to the  
memory card corresponding to history information.

20 The present invention also relates to a data  
processing apparatus, a data processing method, a  
terminal unit, and a transmission method of a data  
processing apparatus for performing a re-encrypting  
process in two stages in such a manner that when the  
terminal unit sends encrypted contents data to the  
server, the terminal unit re-encrypts a key for  
25 decrypting the encrypted contents data and the server  
re-encrypts the re-encrypted key so as to secure the  
copyright protection of the contents data.

## Related Art

EEPROM (Electrically Erasable Programmable ROM) that is an electrically rewritable non-volatile memory requires a large space because each bit is composed of two transistors. Thus, the integration of EEPROM is restricted. To solve this problem, a flash memory that allows one bit to be accomplished with one transistor using all-bit-erase system has been developed. The flash memory is being expected as a successor of conventional record mediums such as magnetic disks and optical discs.

A memory card using a flash memory is also known. The memory card can be freely attached to an apparatus and detached therefrom. A digital audio recording/reproducing apparatus that uses a memory card instead of a conventional CD (Compact Disc: Trademark) or MD (Mini Disc: Trademark) can be accomplished.

Since an audio recorder using a memory card as a record medium records and reproduces digital data, when the audio recorder uses a compressing method that allows data to be reproduced with relatively high quality, the copyright of music data and so forth that are recorded and reproduced should be protected. As an example, using encrypting technologies, memory cards that are not authenticated can be prohibited from being used. In other words, in a combination of an

authenticated recorder and an authenticated memory card, encrypted data is decrypted.

Conventional memory cards do not have an encrypting function. Thus, to record confidential data to a memory card, the recorder should encrypt data and record the encrypted data to a memory card. However, when a decrypting key is stored in a memory card, the security of data cannot be protected. On the other hand, when a decrypting key is stored in the recorder, encrypted data cannot be decrypted by other than the recorder that has encrypted the data. Thus, the compatibility of the memory cards cannot be maintained. For example, data stored in a memory card of one user cannot be decrypted by a recorder of another user. To solve this problem, a system of which both a recorder and a memory card have respective encrypting functions and they authenticate each other for assuring the security of data and the compatibility of the cards has been proposed.

On the other hand, as digital audio/video information and multimedia systems are becoming common, a music data delivering service of which music data is delivered from a music data delivering server to a personal computer through a network such as Internet or a digital broadcast is being accomplished. In such a service, delivered contents data is stored in a hard disk of the personal computer.

In a system of which a hard disk is used as an audio server, audio contents data is moved from the hard disk to a memory card. With the memory card, the moved data can be reproduced by for example a portable player. In contrast, audio data is moved from the memory card to the hard disk of the personal computer. In this case, data is moved from the hard disk to a memory card so that the data is not left in the hard disk.

In the system of which a hard disk is used as an audio server, when data is moved from a memory card to the hard disk, all contents data of the memory card is moved to the hard disk. In this method, since an encrypting process or the like is not required, the structure becomes simple and the data can be moved at high speed. In addition, since the hard disk cannot decrypt stored data, from a viewpoint of the copyright owner, this method is the most safety method.

However, in the case that a contents key stored in the memory card is encrypted with a storage key of the memory card, when the contents key stored in the hard disk is returned to the memory card, other than the original memory card cannot decrypt encrypted data. In other words, even if contents data is moved from the hard disk to another memory card, the contents data cannot be reproduced. In addition, when the original memory card is lost or destroyed, all data

stored therein cannot be used.

An object of the present invention is to solve a problem with respect to a data moving operation and provide a data processing apparatus, a data processing method, a terminal unit, and transmission method of a data processing apparatus that allow a storage key to be used for a storing unit such as a hard disk and to be re-keyed.

Another object of the present invention is to provide a data processing apparatus, a data processing method, a terminal unit, and a transmission method of a data processing apparatus for substantially preventing all contents data of a hard disk from being copied to many memory cards.

#### Disclosure of the Invention

A first aspect of the present invention is a data processing apparatus, comprising a large capacity memory means for storing a plurality of files, a memory means for storing move/copy history when a particular file is moved/copied from the large capacity memory means to a non-volatile memory, a reference means for referencing the history information stored in the memory means when the particular file is moved/copied from the large capacity memory means to the non-volatile memory, and a control means for prohibiting the particular file from being moved/copied from the

large capacity memory means to the non-volatile memory when the reference means has detected that the history information is stored in the memory means.

5 A second aspect of the present invention is a terminal unit having an attachable/detachable non-volatile record medium, comprising an encrypting means for encrypting contents data recorded in the attachable/detachable non-volatile record medium with a first key, encrypting the first key with a second key, 10 and encrypting the first key with a third key, a recording means for recording the first key encrypted by the encrypting means to a management area and recording the encrypted contents data to a program area, and an output means for outputting the first key 15 encrypted with the third key and the contents data encrypted with the first key.

20 A third aspect of the present invention is a data processing apparatus having a terminal unit with an attachable/detachable non-volatile record medium and a server portion for receiving/transmitting encrypted contents data from/to the terminal unit, wherein the terminal unit comprises an encrypting means for encrypting contents data recorded in the attachable/detachable non-volatile record medium with a first key, encrypting the first key with a second key, 25 and encrypting the first key with a third key, a recording means for recording the first key encrypted

by the encrypting means to a management area and recording the encrypted contents data to a program area, and an output means for outputting the first key encrypted with the third key and the contents data encrypted with the first key. and wherein the server portion comprises a receiving means for receiving both the first key encrypted with the third key transmitted from the output means of the terminal unit and the contents data encrypted with the first key, a memory means for storing the third key and a fourth key that is different from the third key, a decrypting means for decrypting the first key encrypted with the third key received by the receiving means with the third key stored in the memory means, an encrypting means for re-encrypting the first key decrypted by the decrypting means with the fourth key stored in the memory means, and a storing means for storing the contents data encrypted with the first key and the first key re-encrypted by the encrypting means.

#### Brief Description of Drawings

Fig. 1 is a block diagram showing the structure of a digital audio recorder/player using a non-volatile memory card according to the present invention; Fig. 2 is a block diagram showing the internal structure of a DSP 30 according to the present invention; Fig. 3 is a block diagram showing the

internal structure of a memory card 40 according to the present invention; Fig. 4 is a schematic diagram showing a file management structure of a memory card as a storage medium according to the present invention;

5 Fig. 5 is a schematic diagram showing the physical structure of data in a flash memory 42 of the memory card 40 according to the present invention; Fig. 6 is a data structure of the memory card 40 according to the present invention; Fig. 7 is a schematic diagram

10 showing the hierarchy of the file structure in the memory card 40; Fig. 8 is a schematic diagram showing the data structure of a reproduction management file PBLIST.MSF that is a sub directory stored in the memory card 40; Fig. 9 is a schematic diagram showing the data structure in the case that one ATRAC3 data file is divided into blocks with a predetermined unit length and that attribute files are added thereto; Fig. 10A is

15 a schematic diagram showing the file structure before two files are edited with a combining process; Fig. 10B is a schematic diagram showing the file structure after two files are edited with a combining process; Fig. 10C is a schematic diagram showing the file structure after one file is edited with a dividing process; Fig. 11 is a schematic diagram showing the data structure of a

20 a reproduction management file PBLIST; Fig. 12A is a schematic diagram showing the data structure of a header portion of the reproduction management file



PBLIST; Fig. 12B is a schematic diagram showing the data structure of a main data portion of the reproduction management file PBLIST; Fig. 12C is a schematic diagram showing the data structure of an additional information data portion of the reproduction management file PBLIST; Fig. 13 is a table that correlates types of additional information data and code values thereof; Fig. 14 is a table that correlates types of additional information data and code values thereof; Fig. 15 is a table that correlates types of additional information data and code values thereof; Fig. 16A is a schematic diagram showing the data structure of additional information data; Fig. 16B is a schematic diagram showing the data structure in the case that additional information data is an artist name; Fig. 16C is a schematic diagram showing the data structure in the case that additional information data is a copyright code; Fig. 16D is a schematic diagram showing the data structure in the case that additional information data is date/time information; Fig. 16E is a schematic diagram showing the data structure in the case that additional information data is a reproduction log; Fig. 17 is a schematic diagram showing a detailed data structure of an ATRAC3 data file; Fig. 18 is a schematic diagram showing the data structure of an upper portion of an attribute header that composes an ATRAC3 data file; Fig. 19 is a schematic diagram

showing the data structure of a middle portion of the attribute header that composes an ATRAC3 data file; Fig. 20 is a table that correlates record modes, record time, and so forth; Fig. 21 is a table showing copy control states; Fig. 22 is a schematic diagram showing the data structure of a lower portion of the attribute header that composes an ATRAC3 data file; Fig. 23 is a schematic diagram showing the data structure of a header of a data block of an ATRAC3 data file; Figs. 24A to 24C are flow charts showing a recovering method according to the present invention in the case that an FTA area was destroyed; Fig. 25 is a schematic diagram showing the file structure in the memory card 40 according to a second embodiment of the present invention; Fig. 26 is a schematic diagram showing the relation between a track information management file TRKLIST.MSF and an ATRAC3 data file A3Dnnnnn.MSA; Fig. 27 is a schematic diagram showing the detailed data structure of the track information management file TRKLIST.MSF; Fig. 28 is a schematic diagram showing the detailed data structure of NAME1 for managing a name; Fig. 29 is a schematic diagram showing the detailed data structure of NAME2 for managing a name; Fig. 30 is a schematic diagram showing the detailed data structure of an ATRAC3 data file A3Dnnnnn.MSA; Fig. 31 is a schematic diagram showing the detailed data structure of INFLIST.MSF that represents additional information;

Fig. 32 is a schematic diagram showing the detailed data structure of INFLIST.MSF that represents additional information data; Fig. 33 is a flow chart showing a recovering method according to the second embodiment of the present invention in the case that an FAT area was destroyed; Fig. 34 is a schematic diagram for explaining a move process according to the present invention; Fig. 35 is a block diagram for explaining a re-keying operation in the move process; Fig. 36 is a block diagram showing the structure of a circuit block that moves/copies data between a first hard disk and a second hard disk, between the first hard disk and a first memory card, and between the second hard disk and a second memory card; and Fig. 37 is a flow chart showing a move/copy process for moving/copying contents data from a host side hard disk to a memory card.

#### Best Modes for Carrying out the Invention

Next, an embodiment of the present invention will be described. Fig. 1 is a block diagram showing the structure of a digital audio recorder/player using a memory card according to an embodiment of the present invention. The digital audio recorder/player records and reproduces a digital audio signal using a detachable memory card. In reality, the recorder/player composes an audio system along with an amplifying unit, a speaker, a CD player, an MD

recorder, a tuner, and so forth. However, it should be noted that the present invention can be applied to other audio recorders. In other words, the present invention can be applied to a portable

5 recording/reproducing apparatus. In addition, the present invention can be applied to a set top box that records a digital audio data that is circulated as a satellite data communication, a digital broadcast, or Internet. Moreover, the present invention can be  
10 applied to a system that records/reproduces moving picture data and still picture data rather than audio data. The system according to the embodiment of the present invention can record and reproduce additional information such as picture and text other than a  
15 digital audio signal.

The recording/reproducing apparatus has an audio encoder/decoder IC 10, a security IC 20, a DSP (Digital Signal Processor) 30. Each of these devices is composed of a one-chip IC. The  
20 recording/reproducing apparatus has a detachable memory card 40. The one-chip IC of the memory card 40 has flash memory (nonvolatile memory), a memory control block, and a security block. The security block has a DES (Data Encryption Standard) encrypting circuit.  
25 According to the embodiment, the recording/reproducing apparatus may use a microcomputer instead of the DSP 30.

The audio encoder/decoder IC 10 has an audio interface 11 and an encoder/decoder block 12. The encoder/decoder block 12 encodes a digital audio data corresponding to a highly efficient encoding method and writes the encoded data to the memory card 40. In addition, the encoder/decoder block 12 decodes encoded data that is read from the memory card 40. As the highly efficient encoding method, the ATRAC3 format that is a modification of the ATRAC (Adaptive Transform Acoustic Coding) format used in Mini-Disc is used.

In the ATRAC3 format, audio data sampled at 44.1 kHz and quantized with 16 bits is highly efficiently encoded. In the ATRAC3 format, the minimum data unit of audio data that is processed is a sound unit (SU). 1 SU is data of which data of 1024 samples (1024 x 16 bits x 2 channels) is compressed to data of several hundred bytes. The duration of 1 SU is around 23 msec. In the highly efficient encoding method, the data amount of audio data is compressed to data that is around 10 times smaller than that of original data. As with the ATRAC1 format used in Mini-Disc, the audio signal compressed and decompressed corresponding to the ATRAC3 format less deteriorates in the audio quality.

A line input selector 13 selectively supplies the reproduction output signal of an MD, the output signal of a tuner, or a reproduction output signal of a tape to an A/D converter 14. The A/D converter 14

converts the input line signal to a digital audio signal (sampling frequency = 44.1 kHz; the number of quantizing bits = 16). A digital input selector 16 selectively supplies a digital output signal of an MD, a CD, or a CS (Satellite Digital Broadcast) to a digital input receiver 17. The digital input signal is transmitted through for example an optical cable. An output signal of the digital input receiver 17 is supplied to a sampling rate converter 15. The sampling rate converter 15 converts the digital input signal into a digital audio signal (sampling frequency = 44.1 kHz; the number of quantizing bits = 16).

The encoder/decoder block 12 of the audio encoder/decoder IC 10 supplies encoded data to a DES encrypting circuit 22 through an interface 21 of the security IC 20. The DES encrypting circuit 22 has a FIFO 23. The DES encrypting circuit 22 is disposed so as to protect the copyright of contents. The memory card 40 also has a DES encrypting circuit. The DES encrypting circuit 22 of the recording/reproducing apparatus has a plurality of master keys and an apparatus-unique storage key. The DES encrypting circuit 22 also has a random number generating circuit. The DES encrypting circuit 22 can share an authenticating process and a session key with the memory card 40 that has the DES encrypting circuit. In addition, the DES encrypting circuit 22 can re-encrypt

data with the storage key of the DES encrypting circuit.

5 The encrypted audio data that is output from the DES encrypting circuit 22 is supplied to a DSP (Digital Signal Processor) 30. The DSP 30 communicates with the memory card 40 through an interface. In this example, the memory card 40 is attached to an attaching/detaching mechanism (not shown) of the recording/reproducing apparatus. The DSP 30 writes the encrypted data to the flash memory of the memory card 10 40. The encrypted data is serially transmitted between the DSP 30 and the memory card 40. In addition, an external SRAM (Static Random Access Memory) 31 is connected to the DSP 30. The SRAM 31 provides the recording/reproducing apparatus with a sufficient storage capacity so as to control the memory card 40. 15

20 A bus interface 32 is connected to the DSP 30. Data is supplied from an external controller (not shown) to the DSP 30 through a bus 33. The external controller controls all operations of the audio system. The external controller supplies data such as a record command or a reproduction command that is generated corresponding to a user's operation through an operation portion to the DSP 30 through the bus 25 interface 32. In addition, the external controller supplies additional information such as image information and character information to the DSP 30.

through the bus interface 32. The bus 33 is a  
bidirectional communication path. Additional  
information that is read from the memory card 40 is  
supplied to the external controller through the DSP  
5 30, the bus interface 32, and the bus 33. In reality,  
the external controller is disposed in for example an  
amplifying unit of the audio system. In addition, the  
external controller causes a display portion to display  
additional information, the operation state of the  
10 recorder, and so forth. The display portion is shared  
by the audio system. Since data that is exchanged  
through the bus 33 is not copyright protected data, it  
is not encrypted.

The encrypted audio data that is read from  
15 the memory card 40 by the DSP 30 is decrypted by the  
security IC 20. The audio encoder/decoder IC 10  
decodes the encoded data corresponding to the ATRAC3  
format. Output data of the audio encoder/decoder 10 is  
supplied to a D/A converter 18. The D/A converter 18  
20 converts the output data of the audio encoder/decoder  
10 into an analog signal. The analog audio signal is  
supplied to a line output terminal 19.

The analog audio signal is supplied to an  
amplifying unit (not shown) through the line output  
25 terminal 19. The analog audio signal is reproduced  
from a speaker or a head set. The external controller  
supplies a muting signal to the D/A converter 18. When



the muting signal represents a mute-on state, the external controller prohibits the audio signal from being output from the line output terminal 19.

Fig. 2 is a block diagram showing the internal structure of the DSP 30. Referring to Fig. 2, the DSP 30 comprises a core 34, a flash memory 35, an SRAM 36, a bus interface 37, a memory card interface 38, and inter-bus bridges. The DSP 30 has the same function as a microcomputer. The core 34 is equivalent to a CPU. The flash memory 35 stores a program that causes the DSP 30 to perform predetermined processes. The SRAM 36 and the external SRAM 31 are used as a RAM of the recording/reproducing apparatus.

The DSP 30 controls a writing process for writing encrypted audio data and additional information to the memory card 40 corresponding to an operation signal such as a record command received through the bus interfaces 32 and 37 and a reading process for reading them therefrom. In other words, the DSP 30 is disposed between the application software side of the audio system that records/reproduces audio data and additional information and the memory card 40. The DSP 30 is operated when the memory card 40 is accessed. In addition, the DSP 30 is operated corresponding to software such as a file system.

The DSP 30 manages files stored in the memory card 40 with the FAT system used in conventional

personal computers. In addition to the file system, according to the embodiment of the present invention, a management file is used. The management file will be described later. The management file is used to manage data files stored in the memory card 40. The management file as the first file management information is used to manage audio data files. On the other hand, the FAT as the second file management information is used to manage all files including audio data files and management files stored in the flash memory of the memory card 40. The management file is stored in the memory card 40. The FAT is written to the flash memory along with the route directory and so forth before the memory card 40 is shipped. The details of the FAT will be described later.

According to the embodiment of the present invention, to protect the copyright of data, audio data that has been compressed corresponding to the ATRAC3 format is encrypted. On the other hand, since it is not necessary to protect the copyright of the management file, it is not encrypted. There are two types of memory cards that are an encryption type and a non-encryption type. However, a memory card for use with the recorder/player that records copyright protected data is limited to the encryption type.

Voice data and image data that are recorded by users are recorded on non-encryption type memory

cards.

Fig. 3 is a block diagram showing the internal structure of the memory card 40. The memory card 40 comprises a control block 41 and a flash memory 42 that are structured as a one-chip IC. A bidirectional serial interface is disposed between the DSP 30 of the recorder/player and the memory card 40. The bidirectional serial interface is composed of ten lines that are a clock line SCK for transmitting a clock signal that is transmitted along with data, a status line SBS for transmitting a signal that represents a status, a data line DIO for transmitting data, an interrupt line INT, two GND lines, two INT lines, and two reserved lines.

The clock line SCK is used for transmitting a clock signal in synchronization with data. The status line SBS is used for transmitting a signal that represents the status of the memory card 40. The data line DIO is used for inputting and outputting a command and encrypted audio data. The interrupt line INT is used for transmitting an interrupt signal that causes the memory card 40 to interrupt the DSP 30 of the recorder/player. When the memory card 40 is attached to the recorder/player, the memory card 40 generates the interrupt signal. However, according to the embodiment of the present invention, since the interrupt signal is transmitted through the data line

DIO, the interrupt line INT is grounded.

A serial/parallel converting, parallel/serial converting, and interface block (S/P, P/S, I/F block) 43 is an interface disposed between the DSP 30 of the recorder/player and the control block 41 of the memory card 40. The S/P, P/S, and IF block 43 converts serial data received from the DSP 30 of the recorder/player into parallel data and supplies the parallel data to the control block 41. In addition, the S/P, P/S, and IF block 43 converts parallel data received from the control block 41 into serial data and supplies the serial data to the DSP 30. When the S/P, P/S, and IF block 43 receives a command and data through the data line DIO, the S/P, P/S, and IF block 43 separates them into these that are normally accessed to the flash memory 42 and those that are encrypted.

In the format of which data is transmitted through the data line DIO, after a command is transmitted, data is transmitted. The S/P, P/S, and IF block 43 detects the code of a command and determines whether the command and data are those that are normally accessed or those that are encoded. Corresponding to the determined result, the S/P, P/S, and IF block 43 stores a command that is normally accessed to a command register 44 and stores data that is normally accessed to a page buffer 45 and a write register 46. In association with the write register

46, the memory card 40 has an error correction code encoding circuit 47. The error correction code encoding circuit 47 generates a redundant code that is an error correction code for data temporarily stored in the page buffer 45.

Output data of the command register 44, the page buffer 45, the write register 46, and the error correction code encoding circuit 47 is supplied to a flash memory interface and sequencer (hereinafter, referred to as memory I/F and sequencer) 51. The memory IF and sequencer 51 is an interface disposed between the control block 41 and the flash memory 42 and controls data exchanged therebetween. Data is written to the flash memory through the memory IF and sequencer 51.

Audio data that has been compressed corresponding to the ATRAC3 format and written to the flash memory (hereinafter, this audio data is referred to as ATRAC3 data) is encrypted by the security IC 20 of the recorder/player and the security block 52 of the memory card 40 so as to protect the copyright of the ATRAC3 data. The security block 52 comprises a buffer memory 53, a DES encrypting circuit 54, and a nonvolatile memory 55.

The security block 52 of the memory card 40 has a plurality of authentication keys and a unique storage key for each memory card. The nonvolatile

memory 55 stores a key necessary for encrypting data. The key stored in the nonvolatile memory 55 cannot be analyzed. According to the embodiment, for example, a storage key is stored in the nonvolatile memory 55.

5 The security block 52 also has a random number generating circuit. The security block 52 authenticates an applicable recorder/player and shares a session key therewith. In addition, the security block 52 re-encrypts contents with the storage key  
10 through the DSE encrypting circuit 54.

For example, when the memory card 40 is attached to the recorder/player, they are mutually authenticated. The security IC 20 of the recorder/player and the security block 52 of the memory  
15 card 40 mutually authenticate. When the recorder/player has authenticated the attached memory card 40 as an applicable memory card and the memory card 40 has authenticated the recorder/player as an applicable recorder/player, they are mutually  
20 authenticated. After the mutual authenticating process has been successfully performed, the recorder/player and the memory card 40 generate respective session keys and share them with each other. Whenever the recorder/player and the memory card 40 authenticate  
25 each other, they generate respective session keys.

When contents are written to the memory card 40, the recorder/player encrypts a contents key with a

session key and supplies the encrypted data to the memory card 40. The memory card 40 decrypts the contents key with the session key, re-encrypts the contents key with a storage key, and supplies the contents key to the recorder/player. The storage key is a unique key for each memory card 40. When the recorder/player receives the encrypted contents key, the recorder/player performs a formatting process for the encrypted contents key, and writes the encrypted contents key and the encrypted contents to the memory card 40.

In the above section, the writing process for the memory card 40 was described. In the following, the reading process for the memory card 40 will be described. Data that is read from the flash memory 42 is supplied to the page buffer 45, the read register 48, and the error correction circuit 49 through the memory IF and the sequencer 51. The error correcting circuit 49 corrects an error of the data stored in the page buffer 45. Output data of the page buffer 45 that has been error-corrected and the output data of the read register 48 are supplied to the S/P, P/S, and IF block 43. The output data of the S/P, P/S, and IF block 43 is supplied to the DSP 30 of the recorder/player through the above-described serial interface.

When data is read from the memory card 40,

the contents key encrypted with the storage key and the contents encrypted with the block key are read from the flash memory 42. The security block 52 decrypts the contents key with the storage key. The security block 52 re-encrypts the decrypted content key with the session key and transmits the re-encrypted contents key to the recorder/player. The recorder/player decrypts the contents key with the received session key and generates a block key with the decrypted contents key. The recorder/player successively decrypts the encrypted ATRAC3 data.

A config. ROM 50 is a memory that stores partition information, various types of attribute information, and so forth of the memory card 40. The memory card 40 also has an erase protection switch 60. When the switch 60 is in the erase protection position, even if a command that causes the memory card 40 to erase data stored in the flash memory 42 is supplied from the recorder/player side to the memory card 40, the memory card 40 is prohibited from erasing the data stored in the flash memory 42. An OSC cont. 61 is an oscillator that generates a clock signal that is the reference of the timing of the process of the memory card 40.

Fig. 4 is a schematic diagram showing the hierarchy of the processes of the file system of the computer system that uses a memory card as a storage



medium. On the hierarchy, the top hierarchical level is an application process layer. The application process layer is followed by a file management process layer, a logical address management layer, a physical address management layer, and a flash memory access layer. In the above-mentioned hierarchical structure, the file management process layer is the FAT file system. Physical addresses are assigned to individual blocks of the flash memory. The relation between the blocks of the flash memory and the physical addresses thereof does not vary. Logical addresses are addresses that are logically handled on the file management process layer.

Fig. 5 is a schematic diagram showing the physical structure of data handled in the flash memory 42 of the memory card 40. In the memory 42, a data unit (referred to as segment) is divided into a predetermined number of blocks (fixed length). One block is divided into a predetermined number of pages (fixed length). In the flash memory, data is erased as each block at a time. Data is written to the flash memory 42 or read therefrom as a page at a time. The size of each block is the same. Likewise, the size of each page is the same. One block is composed of page 0 to page m. For example, one block has a storage capacity of for example 8 KB (kilobytes) or 16 KB. One page has a storage capacity of 512 B (bytes). When one

block has a storage capacity of 8 KB, the total storage capacity of the flash memory 42 is 4 MB (512 blocks) or 8 MB (1024 blocks). When one block has a storage capacity of 16 KB, the total storage capacity of the flash memory 42 is 16 MB (1024 blocks), 32 MB (2048 blocks), or 64 MB (4096 blocks).

One page is composed of a data portion of 512 bytes and a redundant portion of 16 bytes. The first three bytes of the redundant portion is an overwrite portion that is rewritten whenever data is updated.

The first three bytes successively contain a block status area, a page status area, and an update status area. The remaining 13 bytes of the redundant portion are fixed data that depends on the contents of the data portion. The 13 bytes contain a management flag area (1 byte), a logical address area (2 bytes), a format reserve area (5 bytes), a dispersion information ECC area (2 bytes), and a data ECC area (3 bytes). The dispersion information ECC area contains redundant data for an error correction process against the management flag area, the logical address area, and the format reserve area. The data ECC area contains redundant data for an error correction process against 512-byte data.

The management flag area contains a system flag (1: user block, 0: boot block), a conversion table flag (1: invalid, 0: table block), a copy prohibition

flag (1: OK, 0: NG), and an access permission flag (1: free, 0: read protect).

The first two blocks - blocks 0 and 1 are boot blocks. The block 1 is a backup of the block 0. The boot blocks are top blocks that are valid in the memory card. When the memory card is attached to the recorder/player, the boot blocks are accessed at first. The remaining blocks are user blocks. Page 0 of the boot block contains a header area, a system entry area, and a boot and attribute information area. Page 1 of the boot block contains a prohibited block data area. Page 2 of the boot block contains a CIS (Card Information Structure)/IDI (identify Drive Information) area.

The header area of the boot block contains a boot block ID and the number of effective entries. The system entries are the start position of prohibited block data, the data size thereof, the data type thereof, the data start position of the CIS/IDI area, the data size thereof, and the data type thereof. The boot and attribute information contains the memory card type (read only type, rewritable type, or hybrid type), the block size, the number of blocks, the number of total blocks, the security/non-security type, the card fabrication data (date of fabrication), and so forth.

Since the flash memory has a restriction for the number of rewrite times due to the deterioration of

the insulation film, it is necessary to prevent the same storage area (block) from being concentratedly accessed. Thus, when data at a particular logical address stored at a particular physical address is rewritten, updated data of a particular block is written to a non-used block rather than the original block. Thus, after data is updated, the relation between the logical address and the physical address changes. This process is referred to as swap process. Consequently, the same block is prevented from being concentratedly accessed. Thus, the service life of the flash memory can be prolonged.

The logical address associates with data written to the block. Even if the block of the original data is different from the block of updated data, the address on the FAT does not change. Thus, the same data can be properly accessed. However, since the swap process is performed, a conversion table that correlates logical addresses and physical addresses is required (this table is referred to as logical-physical address conversion table). With reference to the logical-physical address conversion table, a physical address corresponding to a logical address designated on the FAT is obtained. Thus, a block designated with a physical address can be accessed.

The DSP 30 stores the logical-physical address conversion table in the SRAM. When the storage

capacity of the RAM is small, the logical-physical address conversion table can be stored to the flash memory. The logical-physical address conversion table correlates logical addresses (2 bytes) sorted in the ascending order with physical addresses (2 bytes). Since the maximum storage capacity of the flash memory is 128 MB (8192 blocks), 8192 addresses can be assigned with two bytes. The logical-physical address conversion table is managed for each segment. Thus, the size of the logical-physical address conversion table is proportional to the storage capacity of the flash memory. When the storage capacity of the flash memory is 8 MB (two segments), two pages are used as the logical-physical address conversion table for each of the segments. When the conversion table is stored in the flash memory, a predetermined one bit of the management flag area in the redundant portion in each page represents whether or not the current block is a block containing the logical-physical address conversion table.

The above-described memory card can be used with the FAT file system of a personal computer system as with the disc shaped record medium. The flash memory has an IPL area, a FAT area, and a route directory area (not shown in Fig. 5). The IPL area contains the address of a program to be initially loaded to the memory of the recorder/player. In

addition, the IPL area contains various types of memory information. The FAT area contains information with respect to blocks (clusters). The FAT has defined unused blocks, next block number, defective blocks, and last block number. The route directory area contains directory entries that are a file attribute, an update date [day, month, year], file size, and so forth.

Next, with reference to Fig. 6, a managing method using the FAT table will be described.

Fig. 6 is a schematic diagram showing a memory map. The top area of the memory map is a partition table portion. The partition table portion is followed by a block area, a boot sector, a FAT area, a FAT backup area, a root directory area, a sub directory area, and a data area. On the memory map, logical addresses have been converted into physical addresses corresponding to the logical-physical address conversion table.

The boot sector, the FAT area, the FAT backup area, the root directory area, the sub directory area, and the data area are referred to as FAT partition area.

The partition table portion contains the start address and the end address of the FAT partition area.

The FAT used for a conventional floppy disk does not have such a partition table. Since the first

track has only a partition table, there is a blank area. The boot sector contains the size of the FAT structure (12 bit FAT or 16 bit FAT), the cluster size, and the size of each area. The FAT is used to manage the position of a file recorded in the data area. The FAT copy area is a FAT backup area. The route directory area contains file names, start cluster addresses thereof, and various attributes thereof. The route directory area uses 32 bytes per file.

The sub directory area is achieved by a directory attribute file as a directory. In the embodiment shown in Fig. 6, the sub directory area has four files named PBLIST.MSF, CAT.MSF, DOG.MSF, and MAN.MFA. The sub directory area is used to manage file names and record positions on the FAT. In other words, the slot of the file name CAT.MSF is assigned address "10" on the FAT. The slot of the file name DOG.MSF is assigned address "10" on the FAT. An area after cluster 2 is used as a data area. In this embodiment, audio data that has been compressed corresponding to the ATRAC3 format is recorded. The top slot of the file name MAN.MSA is assigned address "110" on the FAT. According to the embodiment of the present invention, audio data with the file name CAT.MSF is recorded to cluster 5 to 8. Audio data of DOG-1 as the first half of the file with the file name DOG.MSF is recorded to clusters 10 to 12. Audio data DOG-2 as the second half

of the file with the file name DOG.MSF is recorded in clusters 100 and 101. Audio data with the file name MAN.MSF is recorded in clusters 110 and 111.

In the embodiment of the present invention,  
5 an example of which a single file is divided into two portions and dispersedly recorded is described. In the embodiment, an area "Empty" in the data area is a recordable area. An area after cluster 200 is used for managing file names. The file CAT.MSF is recorded to  
10 cluster 200. The file DOG.MSF is recorded to cluster 201. The file MAN.MSF is recorded to cluster 202. When the positions of the files are changed, the area after cluster 200 is re-arranged. When the memory card is attached, the beginning and the end of the FAT  
15 partition area are recorded with reference to the top partition table portion. After the boot sector portion is reproduced, the root directory area and the sub directory area are reproduced. The slot of the reproduction management information PBLIST.MSF in the  
20 sub directory area is detected. Thus, the address of the end portion of the slot of the file PBLIST.MSF is obtained. In the embodiment, since address "200" is recorded at the end of the file PBLIST.MSF, cluster 200 is referenced.

25 The area after cluster 200 is used for managing the reproduction order of files. In the embodiment, the file CAT.MSA is the first program. The



file DOG.MSA is the second program. The file MAN.MSA is the third program. After the area after cluster 200 is referenced, slots of the files CAT.MSA, DOG.MSA, and MAN.MSA are referenced. In Fig. 6, the end of the slot of the file CAT.MSA is assigned address "5". The end of the slot of the file DOG.MSA is assigned address "10". The end of the slot of the file MAN.MSA is assigned address "110". When an entry address is searched on the FAT with address "5", cluster address "6" is obtained. When an entry address is searched on the FAT with address "6", cluster address "7" is obtained. When an entry address is searched on the FAT with address "8", code "FFF" that represents the end is obtained. Thus, the file CAT.MSA uses clusters 5, 6, 7, and 8. With reference to clusters 5, 6, 7, and 8 in the data area, an area of ATRAC3 data with the file name CAT.MSA can be accessed.

Next, a method for searching the file DOG.MSF that has been dispersedly recorded will be described.

The end of the slot of the file DOG.MSA is assigned address "10". When an entry address on the FAT is searched with address "10", cluster address "11" is obtained. When an entry address on the FAT is searched with address "11" is referenced, cluster address "12" is obtained. When an entry address on the FAT is searched with address "12" is referenced, cluster address "101" is obtained. When entry address "101" is

referenced, code "FFF" that represents the end is  
obtained. Thus, the file DOG.MSF uses clusters 10, 11,  
12, 100, and 101. When clusters 10, 11, and 12 are  
referenced, the first part of ATRAC3 data of the file  
5 DOG.MSF can be accessed. When the clusters 100 and 101  
are referenced, the second part of ATRAC3 data of the  
file DOG.MSF can be accessed. In addition, when an  
entry address is searched on the FAT with address  
"110", cluster address "101" is obtained. When an  
10 entry address "111" is searched on the FAT with address  
"101", code "FFF" that represents the end is obtained.  
Thus, it is clear that the file MAN.MSA uses clusters  
110 and 111. As described above, data files dispersed  
in the flash memory can be linked and sequentially  
15 reproduced.

According to the embodiment of the present  
invention, in addition to the file management system  
defined in the format of the memory card 40, the  
management file is used for managing tracks and parts  
20 of music files. The management file is recorded to a  
user block of the flash memory 42 of the memory card  
40. Thus, as will be described later, even if the FAT  
of the memory card 40 is destroyed, a file can be  
recovered.

25 The management file is generated by the DSP  
30. When the power of the recorder/player is turned  
on, the DSP 30 determines whether or not the memory

card 40 has been attached to the recorder/player. When the memory card has been attached, the DSP 30 authenticates the memory card 40. When the DSP 30 has successfully authenticated the memory card 40, the DSP 30 reads the boot block of the flash memory 42. Thus, the DSP 30 reads the physical-logical address conversion table and stores the read data to the SRAM. The FAT and the route directory have been written to the flash memory of the memory card 40 before the memory card 40 is shipped. When data is recorded to the memory card 40, the management file is generated.

In other words, a record command issued by the remote controller of the user or the like is supplied to the DSP 30 from the external controller through the bus and the bus interface 32. The encoder/decoder IC 10 compresses the received audio data and supplies the resultant ATRAC3 data to the security IC 20. The security IC 20 encrypts the ATRAC3 data. The encrypted ATRAC3 data is recorded to the flash memory 42 of the memory card 40. Thereafter, the FAT and the management file are updated. Whenever a file is updated (in reality, whenever the recording process of audio data is completed), the FAT and the management file stored in the SRAMs 31 and 36 are rewritten. When the memory card 40 is detached or the power of the recorder/player is turned off, the FAT and the management file that are finally supplied from the

SRAMs 31 and 36 are recorded to the flash memory 42. Alternatively, whenever the recording process of audio data is completed, the FAT and the management file written in the flash memory 42 may be rewritten. When audio data is edited, the contents of the management file are updated.

In the data structure according to the embodiment, additional information is contained in the management file. The additional information is updated and recorded to the flash memory 42. In another data structure of the management file, an additional information management file is generated besides the track management file. The additional information is supplied from the external controller to the DSP 30 through the bus and the bus interface 32. The additional information is recorded to the flash memory 42 of the memory card 40. Since the additional information is not supplied to the security IC 20, it is not encrypted. When the memory card 40 is detached from the recorder/player or the power thereof is turned off, the additional information is written from the SRAM of the DSP 30 to the flash memory 42.

Fig. 7 is a schematic diagram showing the file structure of the memory card 40. As the file structure, there are a still picture directory, a moving picture directory, a voice directory, a control directory, and a music (HIFI) directory. According to

the embodiment, music programs are recorded and reproduced. Next, the music directory will be described. The music directory has two types of files. The first type is a reproduction management file  
5 BLIST.MSF (hereinafter, referred to as PBLIST). The other type is an ATRAC3 data file A3Dnnnn.MSA that stores encrypted music data. The music directory can stores up to 400 ATRAC3 data files (namely, 400 music programs). ATRAC3 data files are registered to the  
10 reproduction management file and generated by the recorder/player.

Fig. 8 is a schematic diagram showing the structure of the reproduction management file. Fig. 9 is a schematic diagram showing the file structure of one ATRAC3 data file. The reproduction management file  
15 is a fixed-length file of 16 KB. An ATRAC3 data file is composed of an attribute header and an encrypted music data area for each music program. The attribute data has a fixed length of 16 KB. The structure of the  
20 attribute header is similar to that of the reproduction management file.

The reproduction management file shown in Fig. 8 is composed of a header, a memory card name NM-1S (for one byte code), a memory card name NM2-S (for  
25 two byte code), a program reproduction sequence table TRKTBL, and memory card additional information INF-S. The attribute header (shown in Fig. 9) at the beginning

of the data file is composed of a header, a program name NM1 (for one byte code), a program name NM2 (for two byte code), track information TRKINF (such as track key information), part information PRTINF, and track additional information INF. The header contains information of the number of total parts, the attribute of the name, the size of the additional information, and so forth.

The attribute data is followed by ATRAC3 music data. The music data is block-segmented every 16 KB. Each block starts with a header. The header contains an initial value for decrypting encrypted data. Only music data of an ATRAC3 data file is encrypted. Thus, other data such as the reproduction management file, the header, and so forth are not encrypted.

Next, with reference to Figs. 10A to 10C, the relation between music programs and ATRAC3 data files will be described. One track is equivalent to one music program. In addition, one music program is composed of one ATRAC3 data (see Fig. 9). The ATRAC3 data file is audio data that has been compressed corresponding to the ATRAC3 format. The ATRAC3 data file is recorded as a cluster at a time to the memory card 40. One cluster has a capacity of 16 KB. A plurality of files are not contained in one cluster. The minimum data erase unit of the flash memory 42 is

one block. In the case of the memory card 40 for music data, a block is a synonym of a cluster. In addition, one cluster is equivalent to one sector.

One music program is basically composed of one part. However, when a music program is edited, one music program may be composed of a plurality of parts. A part is a unit of data that is successively recorded. Normally, one track is composed of one part. The connection of parts of a music program is managed with part information PRTINF in the attribute header of each music program. In other words, the part size is represented with part size PRTSIZE (4 bytes) of the part information PRTINF. The first two bytes of the part size PRTSIZE represents the number of total clusters of the current part. The next two bytes represent the positions of the start sound unit (SU) and the end sound unit (SU) of the beginning and last clusters, respectively. Hereinafter, a sound unit is abbreviated as SU. With such a part notation, when music data is edited, the movement of the music data can be suppressed. When music data is edited for each block, although the movement thereof can be suppressed, the edit unit of a block is much larger than the edit unit of a SU.

SU is the minimum unit of a part. In addition, SU is the minimum data unit in the case that audio data is compressed corresponding to the ATRAC3

format. 1 SU is audio data of which data of 1024 samples at 44.1 kHz (1024 x 16 bits x 2 channels) is compressed to data that is around 10 times smaller than that of original data. The duration of 1 SU is around 23 msec. Normally, one part is composed of several thousand SU. When one cluster is composed of 42 SU, one cluster allows a sound of one second to be generated. The number of parts composing one track depends on the size of the additional information. Since the number of parts is obtained by subtracting the header, the program name, the additional data, and so forth from one block, when there is no additional information, the maximum number of parts (645 parts) can be used.

Fig. 10A is a schematic diagram showing the file structure in the case that two music programs of a CD or the like are successively recorded. The first program (file 1) is composed of for example five clusters. Since one cluster cannot contain two files of the first program and the second program, the file 2 starts from the beginning of the next cluster. Thus, the end of the part 1 corresponding to the file 1 is in the middle of one cluster and the remaining area of the cluster contains no data. Likewise, the second music program (file 2) is composed of one part. In the case of the file 1, the part size is 5. The first cluster starts at 0-th SU. The last cluster ends at 4-th SU.



There are four types of edit processes that are a divide process, a combine process, an erase process, and a move process. The divide process is performed to divide one track into two portions. When the divide process is performed, the number of total tracks increases by one. In the divide process, one file is divided into two files on the file system. Thus, in this case, the reproduction management file and the FAT are updated. The combine process is performed to combine two tracks into one track. When the combine process is performed, the number of total tracks decreases by one. In the combine process, two files are combined into one file on the file system. Thus, when the combine process is performed, the reproduction management file and the FAT are updated. The erase process is performed to erase a track. The track numbers after the track that has been erased decrease one by one. The move process is performed to change the track sequence. Thus, when the erase process or the move process is performed, the reproduction management file and the FAT are updated.

Fig. 10B is a schematic diagram showing the combined result of two programs (file 1 and file 2) shown in Fig. 10A. As a result of the combine process, the combined file is composed of two parts. Fig. 10C is a schematic diagram showing the divided result of which one program (file 1) is divided in the middle of

the cluster 2. By the divide process, the file 1 is composed of clusters 0, 1, and the beginning portion of cluster 2. The file 2 is composed of the end portion of cluster 2 and clusters 3 and 4.

5 As described above, according to the embodiment of the present invention, since the part notation is defined, as the combined result (see Fig. 10B), the start position of the part 1, the end position of the part 1, and the end portion of the part 2 can be defined with SU. Thus, to pack the space due to the combined result, it is not necessary to move the music data of the part 2. In addition, as the divided result (see Fig. 10C), it is not necessary to move data and pack the space at the beginning of the file 2.

10 Fig. 11 is a schematic diagram showing the detailed data structure of the reproduction management file PBLIST. Figs. 12A and 12B show a header portion and the remaining portion of the reproduction management file PBLIST. The size of the reproduction management file is one cluster (one block = 16 KB). The size of the header shown in Fig. 12A is 32 bytes. The rest of the reproduction management file PBLIST shown in Fig. 12B contains a name NM1-S area (256 bytes) (for the memory card), a name NM2-S area (512 bytes), a contents key area, a MAC area, an S-YMDhms area, a reproduction sequence management table TRKTBL area (800 bytes), a memory card additional information

INF-S area (14720 bytes), and a header information redundant area. The start positions of these areas are defined in the reproduction management file.

The first 32 bytes of (0x0000) to (0x0010) shown in Fig. 12A are used for the header. In the file, 16-byte areas are referred to as slots. Referring to Fig. 12A, the header are placed in the first and second slots. The header contains the following areas. An area denoted by "Reserved" is an undefined area. Normally, in a reserved area, a null (0x00) is written. However, even if any data is written to a reserved area, the data written in the reserved is ignored. In a future version, some reserved areas may be used. In addition, data is prohibited from being written to a reserved area. When an option area is not used, it is treated as a reserved area.

= BLKID-TL0 (4 bytes)

Meaning: BLOCKID FILE ID

Function: Identifies the top of the reproduction management file.

Value: Fixed value = "TL = 0" (for example, 0x544C2D30)

= MCode (2 bytes)

Meaning: MAKER CODE

Function: Identifies the maker and model of the recorder/player

Value: High-order 10 bits (Maker code); low-order 6 bits (model code).

= REVISION (4 bytes)

Meaning: Number of rewrite times of PBLIST

5

Function: Increments whenever the reproduction management file is rewritten.

Value: Starts at 0 and increments by 1.

= S-YMDhms (4 bytes) (Option)

10

Meaning: Year, month, day, hour, minute, and second recorded by the recorder/player with a reliable clock.

Function: Identifies the last recorded date and time.

Value: bits 25 to 31: Year 0 to 99 (1980 to 2079)

bits 21 to 24: Month 0 to 12

bits 16 to 20: Day 0 to 31

bits 11 to 15: Hour 0 to 23

bits 05 to 10: Minute 0 to 59

20

bits 00 to 04: Second 0 to 29 (two bit interval)

= SY1C+L (2 bytes)

Meaning: Attribute of name (one byte code) of memory card written in NM1-S area.

25

Function: Represents the character code and the language code as one byte code.

Value: Character code (C): High-order one

byte

00: Non-character code, binary number

01: ASCII (American Standard Code for  
Information Interchange)

02: ASCII+KANA

03: Modified 8859-1

81: MS-JIS

82: KS C 5601-1989

83: GB (Great Britain) 2312-80

90: S-JIS (Japanese Industrial

Standards) (for Voice)

Language code (L): Low-order one

byte

Identifies the language based on EBU

Tech 3258

standard.

00: Not set

08: German

09: English

0A: Spanish

0F: French

15: Italian

1D: Dutch

65: Korean

69: Japanese

75: Chinese

When data is not recorded, this area is

all 0.

= SN2C+L (2 bytes)

Meaning: Attribute of name of memory card in  
NM2-S area.

5                   Function: Represents the character code and  
the language coded as one byte code.

Value: Same as SN1C+L

= SINFSIZE (2 bytes)

10                   Meaning: Total size of additional  
information of memory card in INF-S area.

Function: Represents the data size as an  
increment of 16 bytes. When data is not recorded, this  
area is all 0.

Value: Size: 0x0001 to 0x39C (924)

15                   = T-TRK (2 bytes)

Meaning: TOTAL TRACK NUMBER

Function: Represents the number of total  
tracks.

Value: 1 to 0x0190 (Max. 400 tracks)

20                   When data is recorded, this area is all  
0.

= VerNo (2 bytes)

Meaning: Format version number

25                   Function: Represents the major version  
number (high order one byte) and the minor version  
number (low order one byte).

Value: 0x0100 (Ver 1.0)

0x0203 (Ver 2.3)

Next, areas (see Fig. 13B) that preceded by the header will be described.

= NM1-S

5           Meaning: Name of memory card (as one byte code)

Function: Represents the name of the memory card as one byte code (max. 256). At the end of this area, an end code (0x00) is written. The size is  
10           calculated from the end code. When data is not recorded, null (0x00) is recorded from the beginning (0x0020) of this area for at least one byte.

Value: Various character code

= NM2-S

15           Meaning: Name of memory card (as two byte code)

Function: Represents the name of the memory card as two byte code (max. 512). At the end of this area, an end code (0x00) is written. The size is  
20           calculated from the end code. When data is not recorded, null (0x00) is recorded from the beginning (0x0120) of this area for at least two bytes.

Value: Various character code

= CONTENTS KEY

25           Meaning: Value for music program. Protected with MG(M) and stored. Same as CONTENTS KEY.

Function: Used as a key necessary for

calculating MAC of S-YMDhms.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= MAC

Meaning: Forged copyright information check

5 value

Function: Represents the value generated  
with S-YMDhms and CONTENTS KEY.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= TRK-nnn

10 Meaning: SQN (sequence) number of ATRAC3  
data file reproduced.

Function: Represents FNo of TRKINF.

Value: 1 to 400 (0x190)

When there is no track, this area is all  
15 0.

= INF-S

Meaning: Additional information of memory  
card (for example, information with respect to photos,  
songs, guides, etc.)

20 Function: Represents variable length  
additional information with a header. A plurality of  
types of additional information may be used. Each of  
the types of additional information has an ID and a  
data size. Each additional information area including  
25 a header is composed of at least 16 bytes and a  
multiple of 4 bytes. For details, see the following  
section.



Value: Refer to the section of "Data Structure of Additional Information".

= S-YMDhms (4 bytes) (Option)

5       Meaning: Year, month, day, hour, minute, and second recorded by the recorder/player with a reliable clock.

Function: Identifies the last recorded date and time. In this case of EMD, this area is mandatory.

10       Value: bits 25 to 31: Year 0 to 99 (1980 to 2079)

bits 21 to 24: Month 0 to 12

bits 16 to 24: Day 0 to 31

bits 11 to 15: Hour 0 to 23

bits 05 to 10: Minute 0 to 59

15       bits 00 to 04: Second 0 to 29 (two second interval)

As the last slot of the reproduction management file, the same BLKID-TL0, MCode, and REVISION as those in the header are written.

20       While data is being recorded to a memory card, it may be mistakenly or accidentally detached or the power of the recorder/player may be turned off. When such an improper operation is performed, a defect should be detected. As described above, the REVISION  
25       area is placed at the beginning and end of each block. Whenever data is rewritten, the value of the REVISION area is incremented. If a defect termination takes

place in the middle of a block, the value of the REVISION area at the beginning of the block does not match the value of the REVISION area at the end of the block. Thus, such a defect termination can be detected. Since there are two REVISION areas, the abnormal termination can be detected with a high probability. When an abnormal termination is detected, an alarm such as an error message is generated.

In addition, since the fixed value BLKID-TL0 is written at the beginning of one block (16 KB), when the FAT is destroyed, the fixed value is used as a reference for recovering data. In other words, with reference to the fixed value, the type of the file can be determined. Since the fixed value BLKID-TL0 is redundantly written at the header and the end portion of each block, the reliability can be secured. Alternatively, the same reproduction management file can be redundantly recorded.

The data amount of an ATRAC3 data file is much larger than that of the track information management file. In addition, as will be described later, a block number BLOCK SERIAL is added to ATRAC3 data file. However, since a plurality of ATRAC3 files are recorded to the memory card, to prevent them from become redundant, both CONNUM0 and BLOCK SERIAL are used. Otherwise, when the FAT is destroyed, it will be difficult to recover the file. In other words, one

ATRAC3 data file may be composed of a plurality of blocks that are dispersed. To identify blocks of the same file, CONNUM0 is used. In addition, to identify the order of blocks in the ATRAC3 data file, BLOCK SERIAL is used.

Likewise, the maker code (Mcode) is redundantly recorded at the beginning and the end of each block so as to identify the maker and the model in such a case that a file has been improperly recorded in the state that the FAT has not been destroyed.

Fig. 12C is a schematic diagram showing the structure of the additional information data. The additional information is composed of the following header and variable length data. The header has the following areas.

= INF

Meaning: FIELD ID

Function: Represents the beginning of the additional information (fixed value).

Value: 0x69

= ID

Meaning: Additional information key code

Function: Represents the category of the additional information.

Value: 0 to 0xFF

= SIZE

Meaning: Size of individual additional

information

Function: Represents the size of each type of additional information. Although the data size is not limited, it should be at least 16 bytes and a multiple of 4 bytes. The rest of the data should be filled with null (0x00).

Value: 16 to 14784 (0x39C0)

= MCode

Meaning: MAKER CODE

Function: Identifies the maker and model of the recorder/player.

Value: High-order 10 bits (maker code), low-order 10 bits (machine code).

= C+L

Meaning: Attribute of characters in data area starting from byte 12.

Function: Represents the character code and the language code as one byte code.

Value: Same as SNC+L

= DATA

Meaning: Individual additional information

Function: Represents each type of additional information with variable length data. Real data always starts from byte 12. The length (size) of the real data should be at least 4 bytes and a multiple of 4 bytes. The rest of the data area should be filled with null (0x00).

Value: Individually defined corresponding to the contents of each type of additional information.

Fig. 13 is a table that correlates key code values (0 to 63 of additional information and types thereof. Key code values (0 to 31) are assigned to music character information. Key code values (32 to 63) are assigned to URLs (Uniform Resource Locator) (web information). The music character information and URL information contain character information of the album title, the artist name, the CM, and so forth as additional information.

Fig. 14 is a table that correlates key code values (64 to 127) of additional information and types thereof. Key code values (64 to 95) are assigned to paths/others. Key code values (96 to 127) are assigned to control/numeric data. For example, ID = 98 represents TOC-ID as additional information. TOC-ID represents the first music program number, the last music program number, the current program number, the total performance duration, and the current music program duration corresponding to the TOC information of a CD (Compact Disc).

Fig. 15 is a table that correlates key code values (128 to 159) of additional information and types thereof. Key code values (128 to 159) are assigned to synchronous reproduction information. In Fig. 15, EMD stands for electronic music distribution.

Next, with reference to Figs. 16A to 16E,  
real examples of additional information will be  
described. As with Fig. 12C, Fig. 16A shows the data  
structure of the additional information. In Fig. 16B,  
5 key code ID = 3 (artist name as additional  
information). SIZE = 0x1C (28 bytes) representing that  
the data length of additional information including the  
header is 28 bytes; C+L representing that character  
code C = 0x01 (ASCII) and language code L = 0x09  
10 (English). Variable length data after byte 12  
represents one byte data "SIMON & GRAFUNKEL" as artist  
name. Since the data length of the additional  
information should be a multiple of 4 bytes, the rest  
is filled with (0x00).

In Fig. 16C, key code ID = 97 representing  
that ISRC (International Standard Recording Code:  
Copyright code) as additional information. SIZE = 0x14  
15 (20 bytes) representing that the data length of the  
additional information is 20 bytes. C = 0x00 and L =  
20 0x00 representing that characters and language have not  
been set. Thus, the data is binary code. The variable  
length data is eight-byte ISRC code representing  
copyright information (nation, copyright owner,  
recorded year, and serial number).

In Fig. 16D, key code ID = 97 representing  
recorded date and time as additional information. SIZE  
= 0 x 10 (16 bytes) representing that the data length

of the additional information is 16 bytes. C = 0x00  
and L = representing that characters and language have  
not been set. The variable length data is four-byte  
code (32 bit) representing the recorded date and time  
5 (year, month, day, hour, minute, second).

In Fig. 16E, key code ID = 107 representing a  
reproduction log as additional information. SIZE =  
0x10 (16 bytes) representing that the data length of  
the additional information is 16 bytes. C = 0x00 and L  
10 = 0x00 representing that characters and language have  
not been set. The variable length data is a four-byte  
code representing a reproduction log (year, month, day,  
hour, minute, second). When the recorder/player has a  
reproduction log function, it records data of 16 bytes  
whenever it reproduces music data.

Fig. 17 is a schematic diagram showing a data  
arrangement of ATRAC3 data file A3Dnnnn in the case  
that 1 SU is N bytes (for example, N = 384 bytes).  
Fig. 17 shows an attribute header (1 block) of a data  
file and a music data file (1 block). Fig. 17 shows  
20 the first byte (0x0000 to 0x7FF0) of each slot of the  
two blocks (16 x 2 = 32 kbytes). As shown in Fig. 18,  
the first 32 bytes of the attribute header are used as  
a header; 256 bytes are used as a music program area  
NM1 (256 bytes); and 512 bytes are used as a music  
25 program title area NM2 (512 bytes). The header of the  
attribute header contains the following areas.

= BLKID-HD0 (4 bytes)

Meaning: BLOCKID FIELD ID

Function: Identifies the top of an ATRA3 data file.

5 Value: Fixed value = "HD = 0" (For example, 0x48442D30)

= MCode (2 bytes)

Meaning: MAKER CODE

Function: Identifies the maker and model of the recorder/player

Value: High-order 10 bits (maker code); low-order 6 bits (machine code)

= BLOCK SERIAL (4 bytes)

Meaning: Track serial number

Function: Starts from 0 and increments by 1. Even if a music program is edited, this value does not vary.

Value: 0 to 0xFFFFFFFF.

= N1C+L (2 bytes)

20 Meaning: Represents the attribute of data (NM1) of a track (music program title).

Function: Represent the character code and language code of NM1 as one byte code.

Value: Same as SN1C+L

25 = N2C+L (2 bytes)

Meaning: Represents the attribute of data (NM2) of a track (music program title).



Function: Represent the character code and language code of NM1 as one byte code.

Value: Same as SN1C+L

= INFSIZE (2 bytes)

5           Meaning: Total size of additional information of current track.

Function: Represents the data size as a multiple of 16 bytes. When data is not recorded, this area should be all 0.

10           Value: 0x0000 to 0x3C6 (966)

= T-PRT (2 bytes)

Meaning: Number of total bytes

Function: Represents the number of parts that composes the current track. Normally, the value of T-PRT is 1.

Value: 1 to 285 (645 dec).

= T-SU (4 bytes)

Meaning: Number of total SU.

Function: Represents the total number of SU in one track that is equivalent to the program performance duration.

Value: 0x01 to 0x001FFFFFF

= INX (2 bytes) (Option)

Meaning: Relative position of INDEX

25           Function: Used as a pointer that represents the top of a representative portion of a music program. The value of INX is designated with a value of which

the number of SU is divided by 4 as the current position of the program. This value of INX is equivalent to 4 times larger than the number of SU (around 93 msec).

5 Value: 0 to 0xFFFF (max, around 6084 sec)  
= XT (2 bytes) (Option)

Meaning: Reproduction duration of INDEX

Function: Designates the reproduction duration designated by INX-nnn with a value of which the number of SU is divided by 4. The value of INDEX is equivalent to four times larger than the normal SU (around 93 msec).

10 Value: 0x0000 (no setting); 0x01 to 0xFFFE  
(up to 6084 sec); 0xFFFF (up to end of music program)

15 Next, the music program title areas NM1 and NM2 will be described.

= NM1

Means: Character string of music program title

20 Function: Represents a music program title as one byte code (up to 256 characters) (variable length). The title area should be completed with an end code (0x00). The size should be calculated from the end code. When data is not recorded, null (0x00)  
25 should be recorded from the beginning (0x0020) of the area for at least one byte.

Value: Various character codes

= NM2

Means: Character string of music program  
title

Function: Represents a music program title  
as two byte code (up to 512 characters) (variable  
length). The title area should be completed with an  
end code (0x00). The size should be calculated from  
the end code. When data is not recorded, null (0x100)  
should be recorded from the beginning (0x0120) of the  
area for at least two bytes.

Value: Various character codes

Data of 80 bytes starting from the fixed  
position (0x320) of the attribute header is referred to  
as track information area TRKINF. This area is mainly  
used to totally manage the security information and  
copy control information. Fig. 19 shows a part of  
TRKINF. The area TRKINF contains the following areas.

= CONTENTS KEY (8 bytes)

Meaning: Value for each music program. The  
value of CONTENTS KEY is protected in the security  
block of the memory card and then stored.

Function: Used as a key for reproducing a  
music program. It is used to calculate the value of  
MAC.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= MAC (8 bytes)

Meaning: Forged copyright information check

value      Function: Represents the value generated with a plurality of values of TRKINF including contents cumulation numbers and a secret sequence number.

5      The secret sequence number is a sequence number recorded in the secret area of the memory card. A non-copyright protection type recorder cannot read data from the secret area of the memory card. On the other hand, a copyright protection type recorder and a computer that operates with a program that can read data from a memory card can access the secret area.

10      = A (1 byte)

Meaning: Attribute of part.

Function: Represents the information of such as compression mode of a part.

15      Value: The details will be described in the following (see Figs. 19 and 20).

20      Next, the value of the area A will be described. In the following description, monaural mode (N = 0 or 1) is defined as a special joint mode of which bit 7 = 1, sub signal = 0, main signal = (L+R). A non-copyright protection type player may ignore information of bits 2 and 1.

25      Bit 0 of the area A represents information of emphasis on/off state. Bit 1 of the area A represents information of reproduction skip or normal reproduction. Bit 2 of the area A represents information of data type such as audio data, FAX data,

or the like. Bit 3 of the area A is undefined. By a combination of bits 4, 5, and 6, mode information of ATRAC3 is defined as shown in Fig. 20. In other words, N is a mode value of 3 bits. For five types of modes that are monaural (N = 0 or 1), LP (N = 2), SP (N = 4), EX (N = 5), and HQ (N = 7), record duration (64 MB memory card only), data transmission rate, and the number of SU per block are listed. The number of bytes of 1 SU depends on each mode. The number of bytes of 1 SU in the monaural mode is 136 bytes. The number of bytes of 1 SU in the LP mode is 192 bytes. The number of bytes of 1 SU in the SP mode is 304 bytes. The number of bytes of 1 SU in the EX mode is 384 bytes. The number of bytes of 1 SU in the HQ mode is 512 bytes. Bit 7 of the area A represents ATRAC3 modes (0: Dual, 1: JOint).

For example, an example of which a 64 MB memory card is used in the SP mode will be described. A 64-MB memory card has 3968 blocks. In the SP mode, since 1 SU is 304 bytes, one block has 53 SU. 1 SU is equivalent to  $(1024/44100)$  seconds. Thus, one block is  $(1024/44100) \times 53 \times (3968 - 10) = 4863$  seconds = 81 minutes. The transmission rate is  $(44100/1024) \times 304 \times 8 = 104737$  bps.

= LT (one byte)

Meaning: Reproduction restriction flag (bits 7 and 6) and security partition (bits 5 to 0).



upper limit of the value is  $2^{32}$  that is 4,200,000,000.

Used to identify a recorded program.

Value: 0 to 0xFFFFFFFF

YMDhms-S (4 bytes) (Option)

5           Meaning: Reproduction start date and time of  
track with reproduction restriction

Function: Represents the date and time at  
which data reproduction is permitted with EMD.

10           Value: Same as the notation of date and time  
of other areas

= YMDhms-E (4 bytes) (Option)

Meaning: Reproduction end date and time of  
track with reproduction restriction

15           Function: Represents the date and time at  
which data reproduction is expired with EMD.

Value: Same as the notation of date and time  
of other areas

= MT (1 byte) (Option)

20           Meaning: Maximum value of number of permitted  
reproduction times

Function: Represents the maximum number of  
reproduction times designated by EMD.

Value: 1 to 0xFF. When not used, the value  
of the area MT is 00.

25           = CT (1 byte) (Option)

Meaning: Number of reproduction times

Function: Represents the number of

reproduction times in the number of permitted reproduction times. Whenever data is reproduced, the value of the area CT is decremented.

Value: 0x00 to 0xFF. When not used, the value of the area CT is 0x00. When bit 7 of the area LT is 1 and the value of the area CT is 00, data is prohibited from being reproduced.

= CC (1 byte)

Meaning: COPY CONTROL

Function: Controls the copy operation.

Value: bits 6 and 7 represent copy control information. bits 4 and 5 represent copy control information of a high speed digital copy operation. bits 2 and 3 represent a security block authentication level. bits 0 and 1 are undefined.

Example of CC:

(bits 7 and 6)

11: Unlimited copy operation permitted

01: copy prohibited

00: one time copy operation permitted

(bits 3 and 2)

00: analog/digital input recording

MG authentication level is 0.

When digital record operation using data from a CD is performed, (bits 7 and 6): 00 and (bits 3 and 2): 00.

= CN (1 byte) (Option)



Meaning: Number of permitted copy times in high speed serial copy management system

Function: Extends the copy permission with the number of copy times, not limited to one time copy permission and copy free permission. Valid only in first copy generation. The value of the area CN is decremented whenever the copy operation is performed.

Value"

00: Copy prohibited

01 to 0xFE: Number of times

0xFF: Unlimited copy times

The track information area TRKINF is followed by a 24-byte part management information area (PRTINF) starting from 0x0370. When one track is composed of a plurality of parts, the values of areas PRTINF of the individual parts are successively arranged on the time axis. Fig. 22 shows a part of the area PRTINF. Next, areas in the area PRTINF will be described in the order of the arrangement.

= PRTSIZE (4 bytes)

Meaning: Part size

Function: Represents the size of a part.

Cluster: 2 bytes (highest position), start SU: 1 byte (upper), end SU: 1 byte (lowest position).

Value: cluster: 1 to 0x1F40 (8000)

start SU: 0 to 0xA0 (160)

end SU: 0 to 0xA0 (16) (Note that SU

starts from 0.)

= PRTKEY (8 bytes)

Meaning: Part encrypting value

Function: Encrypts a part. Initial value =

5 0. Note that edit rules should be applied.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= CONNUM0 (4 bytes)

Meaning: Initially generated contents  
cumulation number key

10 Function: Uniquely designates an ID of  
contents.

Value: Same value as the value of the  
contents cumulation number initial value key

As shown in Fig. 17, the attribute header of  
15 an ATRAC3 data file contains additional information  
INF. The additional information is the same as the  
additional information INF-S (see Figs. 11 and 12B) of  
the reproduction management file except that the start  
position is not fixed. The last byte position (a  
20 multiple of four bytes) at the end of one or a  
plurality of parts is followed by data of the  
additional information INF.

= INF

25 Meaning: Additional information with respect  
to track

Function: Represents variable length  
additional information with a header. A plurality of

different types of additional information may be arranged. Each of additional information areas has an ID and a data size. Each additional information area is composed of at least 16 bytes and a multiple of 4 bytes.

Value: Same as additional information INF-S of reproduction management file

The above-described attribute header is followed by data of each block of an ATRAC3 data file. As shown in Fig. 23, a header is added for each block. Next, data of each block will be described.

= BLKID-A3D (4 bytes)

Meaning: BLOCKID FILE ID

Function: Identifies the top of ATRAC3 data.

Value: Fixed value = "A3D" (for example, 0x41334420)

= MCode (2 bytes)

Meaning: MAKER CODE

Function: Identifies the maker and model of the recorder/player

Value: High-order 10 bits (maker code); low-order 6 bits (model code)

= CONNUMO (4 bytes)

Meaning: Cumulated number of initially created contents

Function: Designates a unique ID for contents. Even if the contents are edited, the value

of the area CONNUMO is not changed.

Value: Same as the contents cumulation  
number initial key

= BLOCK SERIAL (4 bytes)

5           Meaning: Serial number assigned to each  
track

Function: Starts from 0 and increments by 1.  
Even if the contents are edited, the value of the area  
BLOCK SERIAL is not changed.

10           Value: 0 to 0xFFFFFFFF

= BLOCK-SEED (8 bytes)

Meaning: Key for encrypting one block

Function: The beginning of the block is a  
random number generated by the security block of the  
recorder/player. The random number is followed by a  
value incremented by 1. When the value of the area  
BLOCK-SEED is lost, since sound is not generated for  
around one second equivalent to one block, the same  
data is written to the header and the end of the block.  
15  
20 Even if the contents are edited, the value of the area  
BLOCK-SEED is not changed.

Value: Initially 8-bit random number

= INITIALIZATION VECTOR (8 bytes)

Meaning: Value necessary for  
25 encrypting/decrypting ATRAC3 data

Function: Represents an initial value  
necessary for encrypting and decrypting ATRAC3 data for

each block. A block starts from 0. The next block starts from the last encrypted 8-bit value at the last SU. When a block is divided, the last eight bytes just before the start SU is used. Even if the contents are edited, the value of the area INITIALIZATION VECTOR is not changed.

Value: 0 to 0xFFFFFFFFFFFFFFFF

= SU-nnn

Meaning: Data of sound unit

Function: Represents data compressed from 1024 samples. The number of bytes of output data depends on the compression mode. Even if the contents are edited, the value of the area SU-nnn is not changed. For example, in the SP mode,  $N = 384$  bytes.

Value: Data value of ATRAC3

In Fig. 17, since  $N = 384$ , 42 SU are written to one block. The first two slots (4 bytes) of one block are used as a header. In the last slot (two bytes), the areas BLKID-A3D, MCode, CONNUM0, and BLOCK SERIAL are redundantly written. Thus, M bytes of the remaining area of one block is  $(16,384 - 384 \times 42 - 16 \times 3 = 208)$  bytes. As described above, the eight-byte area BLOCK SEED is redundantly recorded.

When the FAT area is destroyed, all blocks of the flash memory are searched. It is determined whether the value of the area ID BLKID at the beginning of each block is TL0, HD0, or A3D. As shown in Figs.

24A to 24C, at step SP1, it is determined whether or not the value of the area ID BLKID at the beginning of the top block is BLKID-TL0. When the determined result at step SP1 is No, the flow advances to step SP2. At  
5 step SP2, the block number is incremented. Thereafter, at step SP3, it is determined whether or not the last block has been searched.

When the determined result at step SP3 is No, the flow returns to step SP1.

10 When the determined result at step SP1 is Yes, the flow advances to step SP4. At step SP4, it is determined that the searched block is the reproduction management file PBLIST. Thereafter, the flow advances to step SP5. At step SP5, the number of total tracks  
15 T-TRK in the reproduction management file PBLIST is stored as N to the register. For example, when the memory has stored 10 ATRAC3 data files (10 music programs), 10 has been stored in T-TRK.

20 Next, with reference to the value of the number of total tracks T-TRK, TRK-001 to TRK-400 of blocks are successively referenced. In this example, since 10 music programs have been recorded, TRK-001 to TRK-010 of blocks are referenced. Since a file number FNO has been recorded in TRK-XXX (where X = 1 to 400)  
25 at step SP7, a table that correlates the track number TRK-XXX and the file number FNO is stored to the memory. Next, at step SP8, N stored in the register is

decremented. A loop of steps SP6, SP7, and SP8 is repeated until N becomes 0 at step SP9.

When the determined result at step SP9 is Yes, the flow advances to step SP10. At step SP10, the pointer is reset to the top block. The searching process is repeated from the top block. Thereafter, the flow advances to step SP11. At step SP11, it is determined whether or not the value of the area ID BLKID of the top block is BLKID-HD0. When the determined result at step SP11 is No, the flow advances to step SP12. At step SP12, the block number is incremented. At step SP13, it is determined whether or not the last block has been searched.

When the determined result at step SP13 is No, the flow returns to step SP11. The searching process is repeated until the determined result at step SP11 becomes Yes.

When the determined result at step SP11 is Yes, the flow advances to step SP14. At step SP14, it is determined that the block is the attribute header (see Fig. 8) (0x0000 to 0x03FFF shown in Fig. 18) at the beginning of the ATRAC3 data file.

Next, at step SP15, with reference to the file number FNO, the sequence number BLOCK SERIAL of the same ATRAC data file, and the contents cumulation number key CONNUM0 contained in the attribute header, they are stored to the memory. When 10 ATRAC3 data

files have been recorded, since there are 10 blocks of which the value of the area ID BLKID of the top block is BLKID-TL0, the searching process is continued until 10 blocks are searched.

5                   When the determined result at step SP13 is Yes, the flow advances to step SP16. At step SP16, the pointer is reset to the top block. The searching process is repeated from the top block.

10                   Thereafter, the flow advances to step SP17. At step SP17, it is determined whether or not the value of the area ID BLKID of the top block is BLKID-A3D.

15                   When the determined result at step SP17 is No, the flow advances to step SP18. At step SP18, the block number is incremented. Thereafter, at step SP18', it is determined whether or not the last block has been searched. When the determined result at step SP18' is No, the flow returns to step SP17.

20                   When the determined result at step SP17 is Yes, the flow advances to step SP19. At step SP19, it is determined that the block contains ATRAC3 data. Thereafter, the flow advances to step SP20. At step SP20, with reference to the serial number BLOCK SERIAL recorded in the ATRAC3 data block and the contents cumulation number key CONNUM0, they are stored to the  
25                   memory.

                  In the same ATRAC3 data file, the common number is assigned as the contents cumulation number



key CONNUM0. In other words, when one ATRAC3 data file is composed of 10 blocks, a common number is assigned to all the values of the areas CONNUM0.

In addition, when one ATRAC3 data is composed of 10 blocks, serial numbers 1 to 0 are assigned to the values of the areas BLOCK SERIALs of the 10 blocks.

Corresponding to the values of the areas CONNUM0 and BLOCK SERIAL, it is determined whether the current block composes the same contents and the reproduction order of the current block in the same contents (namely, the connection sequence).

When 10 ATRAC3 data files (namely, 10 music programs) have been recorded and each of the ATRAC3 data files is composed of 10 blocks, there are 100 data blocks.

With reference to the values of the areas CONNUM0 and BLOCK SERIAL, the reproduction order of music programs of 100 data blocks and the connection order thereof can be obtained.

When the determined result at step SP19 is Yes, all the blocks have been searched for the reproduction management file, the ATRAC3 data file, and the attribute file. Thus, at step SP21, based on the values of the areas CONNUM0, BLOCK SERIAL, FNO, and TRK-X in the order of block numbers of the blocks stored in the memory, the file connection state is obtained.

After the connection state is obtained, the FAT may be generated in a free area of the memory.

Next, a management file according to a second embodiment of the present invention will be described.

5 Fig. 25 shows the file structure according to the second embodiment of the present invention. Referring to Fig. 25, a music directory contains a track information management file TRKLIST.MSF (hereinafter, referred to as TRKLIST), a backup track information management file TRKLISTB.MSF (hereinafter, referred to as TRKLISTB), an additional information file INFLIST.MSF (that contains an artist name, an ISRC code, a time stamp, a still picture data, and so forth (this file is referred to as INFIST)), an ATRAC3 data file A3Dnnnn.MSF (hereinafter, referred to as A3nnnn). The file TRKLIST contains two areas NAME1 and NAME2. The area NAME1 is an area that contains the memory card name and the program name (for one byte code corresponding to ASCII/8859-1 character code). The area NAME2 is an area that contains the memory card name and the program name (for two byte code corresponding to MS-JIS/Hankul/Chinese code).

Fig. 26 shows the relation between the track information management file TRKLIST, the areas NAME1 and NAME2, and the ATRAC3 data file A3Dnnnn. The file TRKLIST is a fixed-length file of 64 kbytes (= 16 k x 4). An area of 32 kbytes of the file is used for

managing tracks. The remaining area of 32 kbytes is used to contain the areas NAME1 and NAME2. Although the areas NAME1 and NAME2 for program names may be provided as a different file as the track information management file, in a system having a small storage capacity, it is convenient to totally manage the track information management file and program name files.

The track information area TRKINF-nnnn and part information area PRTINF-nnnn of the track information management file TRKLIST are used to manage the data file A3Dnnnn and the additional information INFLIST. Only the ATRAC3 data file A3Dnnnn is encrypted. In Fig. 26, the data length in the horizontal direction is 16 bytes (0 to F). A hexadecimal number in the vertical direction represents the value at the beginning of the current line.

According to the second embodiment, three files that are the track management file TRKLIST (including a program title file), the additional information management file INFLIST, and the data file A3Dnnnn are used. According to the first embodiment (see Figs. 7, 8, and 9), two files that are the reproduction management file PBLIST for managing all the memory card and the data file ATRAC3 for storing programs are used.

Next, the data structure according to the second embodiment will be described. For simplicity,

in the data structure according to the second embodiment, the description of similar portions to those of the first embodiment is omitted.

Fig. 27 shows the detailed structure of the track information management file TRKLIST. In the track information management file TRKLIST, one cluster (block) is composed of 16 kbytes. The size and data of the file TRKLISTB are the same as those of the backup file TRKLISTB. The first 32 bytes of the track information management file are used as a header. As with the header of the reproduction management file PBLIST, the header of the file TRKLIST contains a BLKID-TL0/TL1 (backup file ID) area (4 bytes), an area T-TRK (2 bytes) for the number of total tracks, a maker code area MCode (2 bytes), an area REVISION (4 bytes) for the number of TRKLIST rewrite times, and an area S-YMDhms (4 bytes) (option) for update date and time data. The meanings and functions of these data areas are the same as those of the first embodiment. In addition, the file TRKLIST contains the following areas.

= YMDhms (4 bytes)

Represents the last update date (year, month, day) of the file TRKLIST.

= N1 (1 byte) (Option)

Represents the sequential number of the memory card (numerator side). When one memory card is

used, the value of the area N1 is 0x01.

= N2 (1 byte) (Option)

Represents the sequential number of the  
memory card (denominator side). When one memory card  
is used, the value of the area N2 is 0x01.

= MSID (2 bytes) (Option)

Represents the ID of a memory card. When a  
plurality of memory cards is used, the value of the  
area MSID of each memory card is the same (T.B.D.).  
(T.B.D. (to be defined) represents that this value may  
be defined in future).

= S-TRK (2 bytes).

Represents a special track (T.B.D.).  
Normally, the value of the area S-TRK is 0x0000.

= PASS (2 bytes) (Option)

Represents a password (T.B.D.).

= APP (2 bytes) (Option)

Represents the definition of a reproduction  
application (T.B.D.) (normally, the value of the area  
APP is 0x0000).

= INF-S (2 bytes) (Option)

Represents the additional information pointer  
of the entire memory card. When there is no additional  
information, the value of the area INF-S is 0x00.

The last 16 bytes of the file TRKLIST are  
used for an area BLKID-TL0, an area MCode, and an area  
REVISION that are the same as those of the header. The

backup file TRKLISTB contains the above-described header. In this case, the header contains an area BLKID-TL1, an area MCode, and an area REVISION.

The header is followed by a track information area TRKINF for information with respect to each track and a part information area PRTINF for information with respect to each part of tracks (music programs). Fig. 27 shows the areas preceded by the area TRKLIST. The lower portion of the area TRKLISTB shows the detailed structure of these areas. In Fig. 27, a hatched area represents an unused area.

The track information area TRKINF-nnn and the part information area PRTINF-nnn contain areas of an ATRAC3 data file. In other words, the track information area TRKINF-nnn and the part information area PRTINF-nnn each contain a reproduction restriction flag area LT (1 byte), a contents key area CONTENTS KEY (8 bytes), a recorder/player security block serial number area MG(D) SERIAL (16 bytes), an area XT (2 bytes) (option) for representing a feature portion of a music program, an area INX (2 bytes) (option), an area YMDhms-S (4 bytes) (option), an area YMDhms-E (4 bytes) (option), an area MT (1 byte) (option), an area CT (1 byte) (option), an area CC (1 byte) (option), an area CN (1 byte) (option) (these areas YMDhms-S, YMDhms-E, MT, CT, CC, and CN are used for reproduction restriction information and copy control information),

an area A (1 byte) for part attribute, a part size area  
PRTSIZE (4 bytes), a part key area PRTKEY (8 bytes),  
and a contents cumulation number area CONNUM (4 bytes).  
The meanings, functions, and values of these areas are  
the same as those of the first embodiment. In  
addition, the track information area TRKINF-nnn and the  
part information area PRTINF-nnn each contain the  
following areas.

= T0 (1 byte)

Fixed value (T0 = 0x74)

= INF-nnn (Option) (2 bytes)

Represents the additional information pointer  
(0 to 409) of each track. 00: music program without  
additional information.

= FNM-nnn (4 bytes)

Represents the file number (0x0000 to 0xFFFF)  
of an ATRK3 data file.

The number nnnn (in ASCII) of the ATRAC3 data  
file name (A3Dnnnn) is converted into 0xnnnnn.

= APP\_CTL (4 bytes) (Option)

Represents an application parameter (T.B.D.)  
(Normally, the value of the area APP\_CTL is 0x0000).

= P-nnn (2 bytes)

Represents the number of parts (1 to 2039)  
that compose a music program. This area corresponds to  
the above-described area T-PART.

= PR (1 byte)

Fixed value (PR = 0 x 50).

Next, the areas NAME1 (for one byte code) and NAME2 (for two byte code) for managing names will be described. Fig. 28 shows the detailed structure of the area NAME1 (for one byte code area). Each of the areas NAME1 and NAME2 (that will be described later) is segmented with eight bytes. Thus, their one slot is composed of eight bytes. At 0x8000 that is the beginning of each of these areas, a header is placed. The header is followed by a pointer and a name. The last slot of the area NAME1 contains the same areas as the header.

= BLKID-NM1 (4 bytes)

Represents the contents of a block (fixed value) (NM1 = 0x4E4D2D31).

= PNM1-nnn (4 bytes) (Option)

Represents the pointer to the area NM1 (for one byte code).

= PNM1-S

Represents the pointer to a name representing a memory card.

nnn (= 1 to 408) represents the pointer to a music program title.

The pointer represents the start position (2 bytes) of the block, the character code type (2 bits), and the data size (14 bits).

= NM1-nnn (Option)



Represents the memory card name and music program title for one byte code (variable length). An end code (0x00) is written at the end of the area.

Fig. 29 shows the detailed data structure of the area NAME2 (for two byte code). At 0x8000 that is the beginning of the area, a header is placed. The header is followed by a pointer and a name. The last slot of the area NAME2 contains the same areas as the header.

= BLKID-NM2 (4 bytes)

Represents the contents of a block (fixed value) (NM2 = 0x4E4D2D32).

= PNM2-nnn (4 bytes) (Option)

Represents the pointer to the area NM2 (for two byte code).

PNM2-S represents the pointer to the name representing the memory card. nnn (= 1 to 408) represents the pointer to a music program title.

The pointer represents the start position (2 bytes) of the block, the character code type (2 bits), and the data size (14 bits).

= NM2-nnn (Option)

Represents the memory card name and music program title for two byte code (variable). An end code (0x0000) is written at the end of the area.

Fig. 30 shows the data arrangement (for one block) of the ATRAC3 data file A3Dnnnn in the case that

1 SU is composed of N bytes. In this file, one slot is composed of eight bytes. Fig. 30 shows the values of the top portion (0x0000 to 0x3FF8) of each slot. The first four slots of the file are used for a header. As with the data block preceded by the attribute header of the data file (see Fig. 17) of the first example, a header is placed. The header contains an area BLKID-A3D (4 bytes), a maker code area MCode (2 bytes), an area BLOCK SEED (8 bytes) necessary for encrypting process, an area CONNUM0 (4 bytes) for the initial contents cumulation number, a serial number area BLOCK SERIAL (4 bytes) for each track, and an area INITIALIZATION VECTOR (8 bytes) necessary for encrypting/decrypting process. The second last slot of the block redundantly contains an area BLOCK SEED. The last slot contains areas BLKID-A3D and MCode. As with the first embodiment, the header is followed by the sound unit data SU-nnnn.

Fig. 31 shows the detailed data structure of the additional information management file INFLIST that contains additional information. In the second embodiment, at the beginning (0x0000) of the file INFLIST, the following header is placed. The header is followed by the following pointer and areas.

= BLKID-INF (4 bytes)

Represents the contents of the block (fixed value) (INF = 0x494E464F).



INF-409).

Fig. 32 shows the structure of additional information. An 8-byte header is placed at the beginning of one additional information data area. The structure of the additional information is the same as that of the first embodiment (see Fig. 12C). In other words, the additional information contains an area IN (2 bytes) as an ID, an area key code ID (1 byte), an area SIZE (2 bytes) that represents the size of each additional information area, and a maker code area MCode (2 bytes). In addition, the additional information contains an area SID (1 byte) as a sub ID.

According to the second embodiment of the present invention, in addition to the file system defined as a format of the memory card, the track information management file TRKLIST or music data is used. Thus, even if the FAT is destroyed, the file can be recovered. Fig. 33 shows a flow of a file recovering process. To recover the file, a computer that operates with a file recovery program and that can access the memory card and a storing device (hard disk, RAM, or the like) connected to the computer are used. The computer has a function equivalent to the DSP30. Next, a file recovering process using the track management file TRKLIST will be described.

All blocks of the flash memory whose FAT has been destroyed are searched for TL-0 as the value

(BLKID) at the top position of each block. In addition, all the blocks are searched for NM-1 as the value (BLKID) at the top position of each block. Thereafter, all the blocks are searched for NM-2 as the value (BLKID) at the top position of each block. All the contents of the four blocks (track information management file) are stored to for example a hard disk by the recovery computer.

The number of total tracks is obtained from data after the fourth byte of the track information management file. The 20-th byte of the track information area TRKINF-001, the value of the area CONNUM-001 of the first music program, and the value of the next area P-001 are obtained. The number of parts is obtained with the value of the area P-001. The values of the areas PRTSIZE of all parts of the track 1 of the area PRTINF is obtained. The number of total blocks (clusters) n is calculated and obtained.

After the track information management file is obtained, the flow advances to step 102. At step 102, a voice data file (ATRAC3 data file) is searched. All blocks of other than the management file is searched from the flash memory. Blocks whose top value (BLKID) is A3D are collected.

A block of which the value of the area CONNUM0 at the 16-th byte of A3Dnnnn is the same as that of the area CONNUM-001 of the first music program

of the track information management file and of which  
the value of the area BLOCK SERIAL that starts from 20-  
th byte is 0 is searched. After the first block is  
obtained, a block (cluster) with the same value of the  
area CONNUM value as the first block and of which the  
value of BLOCK SERIAL is incremented by 1 ( $1 = 0 + 1$ )  
is searched. After the second block is obtained, a  
block with the same value of the area CONNUM0 as the  
second block and of which the value of the area BLOCK  
SERIAL is incremented by 1 ( $2 = 1 + 1$ ) is searched.

By repeating the process, the ATRC3 data file  
is searched until n blocks (clusters) of the track 1  
are obtained. When all the blocks (clusters) are  
obtained, they are successively stored to the hard  
disk.

The same process for the track 1 is performed  
for the track 2. In other words, a block of which the  
value of the area CONNUM0 is the same as that of the  
area CONNUM-002 of the first music program of the track  
information management file and of which the value of  
the area BLOCK SERIAL that starts at the 20-th byte is  
searched. Thereafter, in the same manner as the track  
1, the ATRAC3 data file is searched until the last  
block (cluster) n' is detected. After all blocks  
(clusters) are obtained, they are successively stored  
to the hard disk.

By repeating the above-described process for

all tracks (the number of tracks: m), all the ATRAC3 data is stored to the hard disk controlled by the recovering computer.

At step 103, the memory card whose the FAT has been destroyed is re-initialized and then the FAT is reconstructed. A predetermined directory is formed in the memory card. Thereafter, the track information management file and the ATRAC3 data file for m tracks are copied from the hard disk to the memory card.

Thus, the recovery process is finished.

In the management file and data file, important parameters (in particular, codes in headers) may be recorded triply rather than doubly. When data is redundantly recorded, the same data may be recorded at any positions as long as they are apart from each other for one page or more.

In the first and second embodiments, as an example of the player/recorder of the system audio set, a memory card recorder was described. According to the present invention, a digital signal reproduced by a CD player is stored to a hard disk. The hard disk is used as an audio server. The digital signal is moved from the hard disk to a memory card 40 having the above-described format. Thus, with the above-described digital audio player/recorder or portable player/recorder, the user can listen to the reproduced digital audio data. Next, corresponding to the first

embodiment shown in Figs. 7 to 23 and the second embodiment shown in Figs. 25 to 32, the structure that moves contents data from the hard disk to the memory card will be described in detail.

5            Fig. 34 is a schematic diagram showing a storing apparatus having a hard disk. The storing apparatus is for example a personal computer. In the following description, the storing unit is simply referred to as host or host side. In Fig. 34,  
10 reference numeral 201 is a hard disk drive. The hard disk drive 201 is operated under the control of a CPU 202. In association with the CPU 202, an external non-volatile memory (external NVRAM) 203, an operation button portion 204, and a display device 205 are disposed.

15            In addition, an ATRAC3 audio encoder/decoder 206 is disposed. An analog input signal 207 is supplied to an A/D converter 208. The A/D converter 208 converts the analog signal 207 into a digital audio  
20 signal. The audio encoder/decoder 206 compresses the digital audio signal that is output from the A/D converter 208 corresponding to ATRAC3. In addition, a digital input signal 210 is supplied from a CD player 209. The digital input signal 210 is supplied to the  
25 audio encoder/decoder 206 through a digital input receiver 211. The audio encoder/decoder 206 compresses the digital input signal 210 that is received from the



digital input receiver 211 corresponding to ATRAC3.  
The host side decodes audio data stored in the hard  
disk drive 201. The audio encoder/decoder 206 decodes  
the audio data that is read from the hard disk drive  
201 into a digital audio signal. The digital audio  
signal is supplied to a D/A converter 213. The D/A  
converter 213 converts the digital audio signal that is  
received from the audio encoder/decoder 206 into an  
analog audio signal. The D/A converter 213 outputs an  
analog audio signal 214. Alternatively,  
compressed/non-compressed digital audio data may be  
downloaded to the hard disk HDD 201 through Internet  
and a public telephone line (not shown).

The compressed audio data is supplied from  
the audio encoder/decoder 206 to a security block S-SAM  
(D) 212 of the host side. The security block S-SAM (D)  
212 encrypts the compressed audio data. As with the  
audio recorder, the compressed audio data is encrypted  
using a contents key. The encrypted ATRAC3 data is  
stored to the hard disk drive 201 under the control of  
the CPU 202. In the case of the digital input signal,  
information such as ISRC (Industry Standard Recoding  
Code) and TOC (Table Of Content)\_ID that identify music  
programs recorded on a disc can be obtained. The  
security block S-SAM (D) 212 generates a contents key  
and a contents cumulation number CONNUM for each  
contents title (audio file (track) in the first

embodiment). In addition, each host is assigned a unique serial number. These values are stored in the hard disk drive 201 and/or the external non-volatile memory 203.

5 To allow an encrypted ATRAC3 data file stored in the hard disk drive 201 to be reproduced by other than the unit (host) that has encrypted the ATRAC3 data file, the encrypted ATRAC3 data file is moved to the memory card 40. The moved data file is not left in the  
10 hard disk unlike with the copying process.

Since the ATRAC3 data has been encrypted with a contents key, unless it is decrypted on the copied side, it cannot be reproduced. However, when the contents key as an encrypting key is stolen, encrypted data can be easily decrypted. To prevent such a  
15 problem, the contents key itself is encrypted. The contents key is not exposed to the outside. For example, when ATRAC3 data is moved from the hard disk drive 201 to the memory card 40, the contents key is  
20 encrypted with a session key. The encrypted contents key is sent from the hard disk drive 201 to the memory card 40. The memory card 40 decrypts the contents key with the session key. Thereafter, the memory card 40 encrypts the contents data with a storage key thereof.  
25 The encrypted contents key is stored in the memory card 40.

Likewise, when data is moved from the memory

card 40 to the hard disk drive 201, the memory card 40 encrypts a contents key with a session key and sends the encrypted contents key to the hard disk drive 201. Thus, the value of the contents key stored in the hard disk drive 201 is different from the value of the contents key stored in the memory card 40. Thus, a pair of audio data and contents key should be stored on the moved side.

Next, with reference to Fig. 35, the data move process will be described in detail. First of all, a data move process for moving data formatted for the audio player/recorder shown in Fig. 1 and recorded in the memory card 40 to the hard disk drive 201 of the host side will be described. In the initial state of which the power of the host side is turned on, it is determined whether or not the memory card 40 has been attached. When the memory card 40 has been attached, the host side and the memory card 40 are authenticated each other. When they have been successfully authenticated, the host side and the memory card side share a session key Sek.

Next, the host reads data from the memory card 40. According to the first embodiment of the present invention, the contents key CK is read from the reproduction management file PBLIST. In contrast, according to the second embodiment of the present invention, a contents key CK (DES (Data Encryption

Standard) (Kstm, CK)) encrypted with a storage key Kstm that is unique to each memory card 40 is extracted from the track information area TRKINF. The DES (Kstm, CK) is sent from the host to the memory card 40. The memory card 40 decrypts the encrypted contents key DES (Kstm, CK) with the storage key Kstm. The decrypted contents key is encrypted with the session key Sek.

The contents key DES (Sek, CK) encrypted with the session key Sek is sent from the memory card 40 to the host side. The host side decrypts the contents key CK with the session key Sek, re-encrypts the decrypted contents key CK with a storage key Kstd that is unique thereto, and stores the re-encrypted storage key to the hard disk drive 201. In other words, the key is stored as a new contents key. The storage keys Kstd and Kstm are stored in such a manner that their values cannot be read from the outside.

In Fig. 35, a security block 212a of the host side and a security block of the memory card 40 authenticate each other and they share a session key Sek. The security block 212a supplies a storage key Kstd and a contents key CK to an encrypting device 212b. The encrypting device 212b creates an encrypted contents key DES (Dstd, CK).

As denoted by a path 215, encrypted ATRAC3 data is moved from the memory card 40 to the host side. The ATRAC3 data is stored to the hard disk drive 201.

In this case, as described with reference to Fig. 27, the track management information TRKINF recorded in the memory card 40 is sent to the host side along with a data file. In particular, the contents cumulation number (CONNUM), the S-SAM serial number, and the file number FNM-nnnn for each music program are directly copied to the track information area TRKINF-nnnn and recorded as a track information area TRKINF of the host side. Unlike with the contents key, these attribute information is not encrypted.

Unless these information is moved to the host side, even if audio data is stored to the hard disk drive 20, the audio data stored in the host cannot be decrypted. Unless the audio data stored in the hard disk is moved to the memory card, the audio data cannot be reproduced.

The contents cumulation number CONNUM is a cumulation number of which each music program is recorded through encrypting devices of security blocks of the memory card 40 and the host side. The contents cumulation number CONNUM has a combination of  $2^{32} = 4,200,000,000$ . The non-volatile memory of each encrypting device stores the last contents cumulation number. Thus, the contents cumulation number is not redundant in each memory card. The S-SAM serial number (SERIAL) is a number unique to each encrypting device. The S-SAM serial number has a combination of  $2^{128}$ .

Thus, the S-SAM serial number is not redundant. The file number FNM-nnnn is a number assigned to each ATRAC3 data file. The file number FNM-nnnn is assigned by hardware. Thus, the file number FNM-nnnn may be redundant. Consequently, the contents cumulation number CONNUM and the S-SAM serial number (SERIAL) are added as auxiliary numbers. Thus, with a total of three types of numbers, a data file (track or music program) can be identified.

As described above, to perform an authenticating process and an encrypting process, the security block 212 of the host side creates or provides:

- self unique number (S-SAM serial number),
- contents key CK (created for each contents title),

- storage key Kstd, and
- session key Sek

According to the first embodiment of the present invention, the S-SAM serial number, the contents key CK, the contents cumulation number CONNUM, and the file number FNM-nnn are recorded so that they correlate with MG (D) Serial-nnn of A3Dnnnn.MSA (ATRAC data file), CONTENTSKEY, CONNUM, and Block Serial shown in Fig. 17, respectively.

According to the second embodiment of the present invention, the hard disk drive 201 of the host

side and/or the external non-volatile memory 203 has a track information area TRKINF paired with an audio data file. The track information area TRKINF contains:

file number FNM-nnnn,  
encrypted contents key CK,  
S-SAM serial number, and  
contents cumulation number CONNUM.

When digital data is directly recorded from for example the CD player 209 to the hard disk drive 201, the audio encoder/decoder 206 compresses audio data corresponding to ATRAC3. The security block.212 of the host side creates a contents key CK for each contents title (music program) and encrypts the contents key with the storage key Kstd unique thereto. The encrypting device 212c encrypts ATRAC3 data with the encrypted contents key DES (Kstd, CK) and stores the encrypted audio data 216 to the hard disk drive 201. At this point, the security block 212a of the host side creates the contents cumulation number CONNUM and the S-SAM (D) serial number for each music program. According to the first embodiment of the present invention, the contents cumulation number CONNUM and the S-SAM (D) serial number are stored as the A3Dnnnn.MSA (ATRAC data file) shown in Fig. 17. According to the second embodiment of the present invention, the contents cumulation number CONNUM and the S-SAM (D) serial number are stored as the track

information area TRKINF to the hard disk drive 201.  
However, these attribute information is not encrypted  
with the storage key Kstd unlike with the contents key.

In addition, the host itself decrypts and  
reproduces contents data stored in the hard disk drive  
201. With the operation button portion 204, the user  
can record and reproduce contents data on the host side  
with reference to information displayed on the display  
device 205.

When digital data is copied from the CD  
player 209 to the hard disk drive 201 of the host side,  
the digital receiver 211 can obtain information that  
identifies a music program recorded on a CD (the  
information is for example TOC\_ID or ISRC of each music  
program). When digital data received from the CD  
player 209 is copied, the digital receiver 211 assigns  
a directory name for each CD.

In contrast, data can be moved from the host  
side to the memory card 40. In this case, the host  
side and the memory card 40 authenticate each other.  
When they have successfully authenticated each other,  
they share a session key Sek. The host reads a  
contents key DES (Kstd, CK) from the hard disk drive  
201 and decrypts it with a storage key Kstd. The host  
encrypts the decrypted contents key with a session key  
Sek and sends the encrypted contents key DES (Sek, CK)  
to the memory card 40.



5 The memory card 40 decrypts a contents key CK  
with a session key Sek. Thereafter, the memory card 40  
re-encrypts the contents key CK with a storage key Kstm  
that is unique thereto. According to the first  
embodiment of the present invention, the encrypted  
contents key DES (Kstm, CK) is stored in the  
reproduction management file PBLIST and the ATRAC data  
file. According to the second embodiment of the  
present invention, the encrypted contents key DES  
10 (Kstm, CK) is stored in the track information area  
TRKINF. Information (for example, contents cumulation  
number CONNUM and S-SAM () serial number) other than  
the contents key is not re-encrypted, but directly  
recorded.

15 In Fig. 35, input digital audio data is  
supplied to an audio encoder/decoder 206. The audio  
encoder/decoder 206 converts the input digital audio  
data into ATRAC3 data. When encoded digital audio data  
is supplied from Internet or the memory card, an  
20 encrypted contents key is decrypted with a session key  
stored on the host side. With the decrypted contents  
key, the audio data is decrypted into ATRAC3 data by an  
encrypting device 212d.

25 The decrypted ATRAC3 data is encrypted by an  
encrypting device 212e with a contents key of which the  
contents key encrypted with the session key is re-  
encrypted with a storage key. The encrypted ATRAC3

data is recorded to a hard disk drive HDD 201.

According to an embodiment of the present invention, to securely prevent audio data from being illegally copied, when the audio data is moved from the  
5      hose side to a memory card 40, information that represents a move history is stored to an external non-volatile memory 203. In other words, the hose side manages the move history that represents what music programs have been moved. Since the move history is  
10     stored to the external non-volatile memory 203 rather than the hard disk drive HDD 201, audio data recorded in the hard disk drive HDD 201 can be prevented from being illegally copied to a memory card. In other words, unless move information is recorded in the hard  
15     disk drive HDD 201, even if audio data recorded therein is illegally copied, moved data cannot be moved again.

Fig. 36 shows a process for preventing audio data from being illegally copied. First of all, a copy process for copying audio data from a hard disk drive  
20     HDD 1 that stores audio data will be described. Before performing a move process (that will be described later), 10 music programs stored in the hard disk drive HDD 1 are copied to a hard disk drive HDD 2. A host  
25     side CPU 202 and an external non-volatile memory 203 manage move history information. Thereafter, as described above, 10 music programs and a contents key that have been encrypted are moved from the hard disk

drive HDD 1 to a first memory card 40X. In this case, as a precondition, the memory card 40X should have been correctly authenticated with the host side. When the audio data is moved, the encrypted contents key necessary for decrypting the audio data that has been moved to the memory card 40X is also sent to the memory card 40X. In such a manner, 10 music programs of audio data are completely moved from the hard disk drive HDD 1 to the memory card 40X.

Next, a move process for moving 10 music programs of music data from the hard disk drive HDD 1 to the hard disk drive HDD 2 will be described. In this case, a second memory card 40Y is used. Since the host side has a security block 212, it correctly authenticates the memory card 40Y and shares a session key Sek with the memory card 40Y. Thus, the contents key CK encrypted with the session key Sek can be moved from the hard disk drive HDD 2 to the memory card 40Y. After the memory card 40Y is correctly authenticated, when the encrypted data is moved to the memory card 40Y, the data stored therein can be decrypted and reproduced. When music programs are copied to a plurality of hard disk drives and the music programs are copied from a hard disk drive to a memory card, the music programs can be unlimitedly copied. Thus, the copyright of the music programs are violated. When 10 music programs stored in the hard disk drive HDD 1 on

one host side are copied or moved to a hard disk drive on another host side, move history information stored in an external non-volatile memory NVRAM is prohibited from being copied/moved to the hard disk drive HDD 2.

5           Thus, even if the user tries to move a particular music program of the 10 music programs stored in the hard disk drive HDD 2, since the move history information is not stored in the external non-volatile memory NVRAM, the music program is prohibited from being copied or moved. Each of the host sides has at least a hard disk and an external non-volatile memory NVRAM.

10           In the above-described embodiment, when music data is moved, move history information is stored to the external non-volatile memory NVRAM. Alternatively, when contents data stored in the hard disk drive HDD 1 on the host side is copied to a memory card, move history information may be created. However, according to the embodiment of the present invention, since the external non-volatile memory 203 stores move history of the 10 music programs, corresponding to the move history, encrypted audio data is prohibited from being moved from the host side to the memory card 40Y.

20           Corresponding to a flow chart shown in Fig. 37, the host side CPU 202 references the history information stored in the non-volatile memory 203 and determines whether or not to permit audio data to be

moved. The memory card 40 sends a move request that designates a music program stored in the hard disk drive HDD 201 to the CPU 202 (at step S201). Thereafter, the CPU 202 checks the external non-volatile memory 203 for the move history of the designated music program (at step S202). In other words, the CPU 202 determines whether or not the designated music program has been moved corresponding to the move request (at step S203).

When the determined result at step S203 is No, the flow advances to step S204. At step S204, the designated music program is moved from the host side hard disk drive HDD 201 to the memory card 40 (at step S204). In addition, the move history is recorded to the external non-volatile memory 203. When the determined result at step S203 is Yes, the host side CPU 202 prohibits the designated music program from being moved from the hard disk drive HDD 201 (at step S205). In this case, the display device 205 displays a message that represents that the designated music program has been moved. Alternatively, a synthesizing means may generate an audio message that represents that the designated music program has been moved.

In the above description, data communication between a hard disk drive and a memory card that are storing units was described. Alternatively, a host having a hard disk drive (in this case, the host is for

example a personal computer) may interface with a terminal unit of an electronic contents delivering system. In this case, a process similar to a move process performed between the hard disk drive and the memory card is performed between the terminal unit and the personal computer.

In the above embodiment, the case that contents data is audio data was described. Of course, the present invention can be applied to video data, program data, and so forth other than audio data. In addition, the present invention can be applied to other storage mediums such as a magneto-optical disc, a phase change type disc, and a semiconductor memory other than a hard disk.

According to the present invention, an encrypting device is also disposed on the storing unit side. A contents key encrypted with a session key and contents data (data file) encrypted with the contents key are received from a memory card as a storage medium. After the contents key is decrypted with the session key, the contents key is re-encrypted with a key unique to the storing unit. Since the contents key is re-keyed, even if the contents data is moved to other than the original memory card, the contents data can be decrypted. In addition, when contents data is moved from the storing unit to the memory card, the contents key is re-keyed. Thus, the contents moved to

a memory card can be decrypted by another unit.

In addition to a medium that stores contents data, move history information is stored in a non-volatile memory. Thus, contents data of a medium can be securely prevented from being illegally copied to another medium.

**SECRET**